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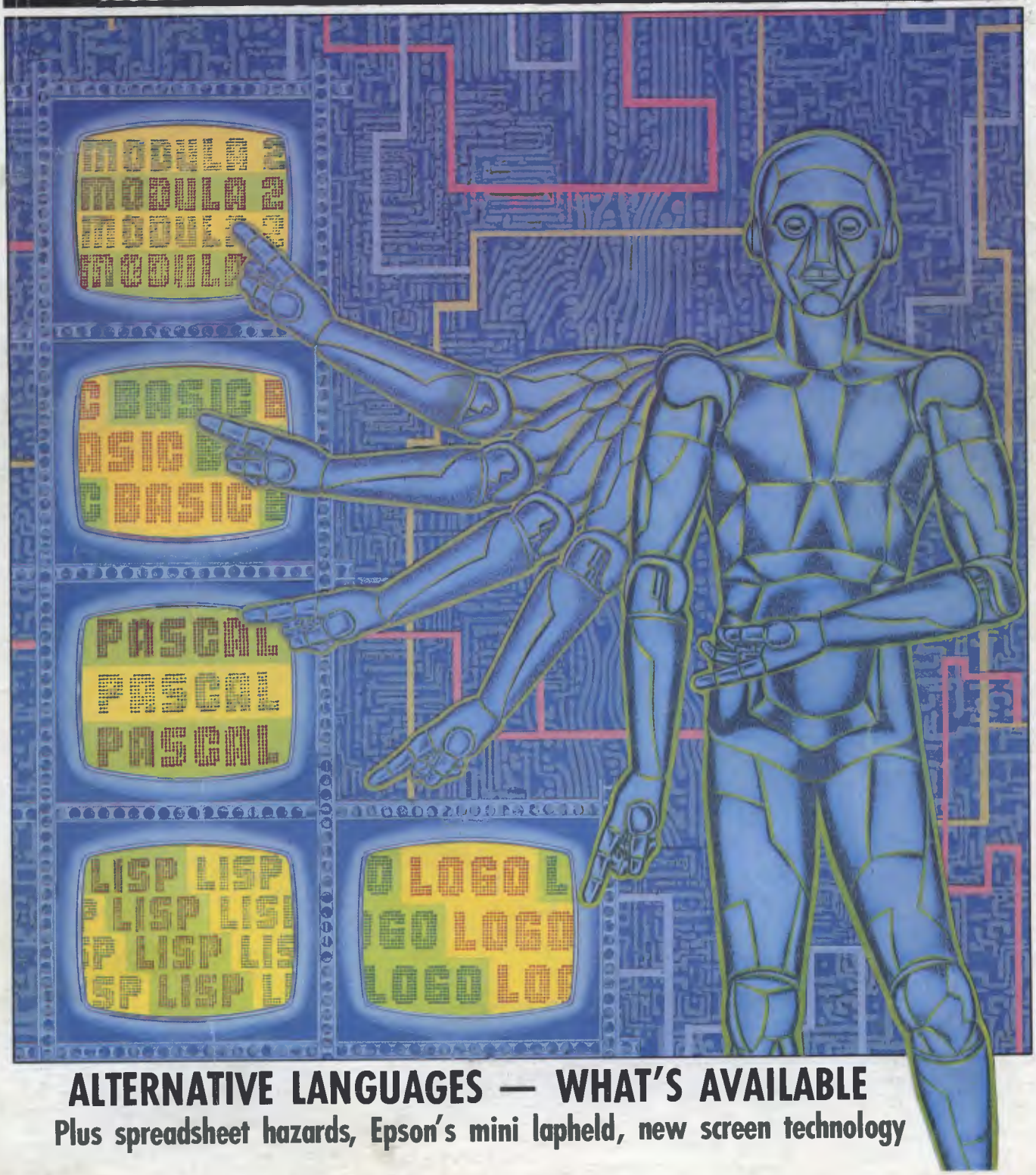
AUSTRALIA'S TOP SELLING COMPUTER MAGAZINE



ALTERNATIVE LANGUAGES — WHAT'S AVAILABLE

Plus spreadsheet hazards, Epson's mini lapheld, new screen technology

NOW WITH 80286 & Z80H

Universe

Security and spee of
Software compatibility, an e

Forget conventional networking. Universe provides superior speed and security necessary in multiuser applications. Running the widest range of 8 and 16 bit software, it has the ability to network IBM PCs and workalikes in the fastest multiuser/ networking microcomputer system in the world.

Tough
The Universe is built on a strong square tube frame.

Stays Cool
No fancy operating environment needed. Every Universe is tested at 42 degrees C.

Flexible
Universe accepts an extensive range of terminals, printers, modems, even electronic telex.

Expandable
20 slot shielded S100 buss. Obsolescence proof using IEEE 696 S100 cards.

Multiuser – efficiency
A single Universe runs up to 25 workstations, each with any combination of 8 and 16 bit programs. Advanced AED network technology allows expansion to 100's of users.

Multitasking – productivity
Each operator can use any four 8 and 16 bit programs at the same time. Switching screens takes only a single keystroke.

Networking – flexibility
Up to 255 MS-DOS machines. IBM PCs and workalikes can be linked into the Universe system using a high speed DR Net local area network.

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Software – compatibility
Dual processor design, provides access to the world's largest software base via CP/M, MP/M and MS-DOS. With AED's new Concurrent DOS you have the best of all worlds.

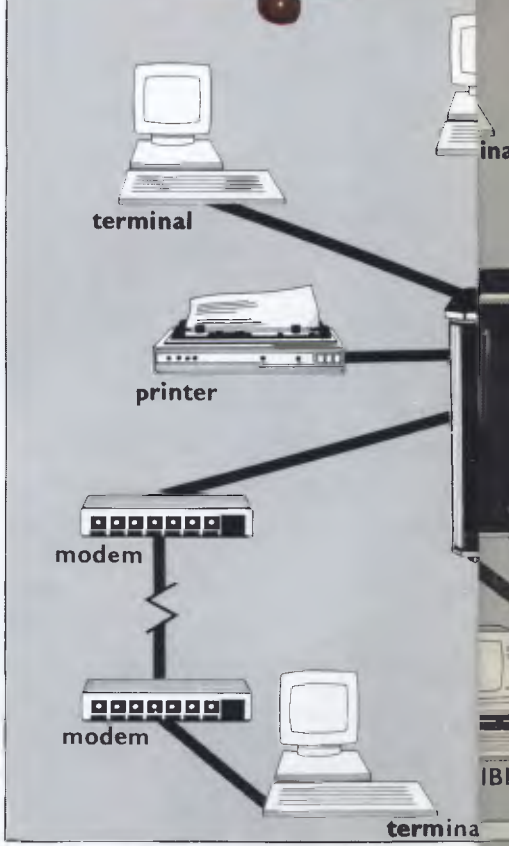
DMA hard discs and the new high-speed 80286/Z80H dual processor CPU furnish performance necessary to handle multiple 8 and 16 bit programs.

Speed and Security – essential to your business
Most networks are slow and insecure. Universe shines here, with full multilevel security enhancements normally found on well engineered minicomputers. Universe is engineered from the ground up to provide facilities essential for the smooth running of a large multiuser system.

Important Security features
Encrypted login passwords. Users are restricted to specific terminals, directory areas, programs and nodes on the network.

File passwords. File and record lockout and a full password hierarchy. Your System Manager can quickly and easily configure the system so that each terminal only has access to those facilities and data its operator needs. For example:

- ☐ Option to restrict any account to specific programs or workstations



Multiuser

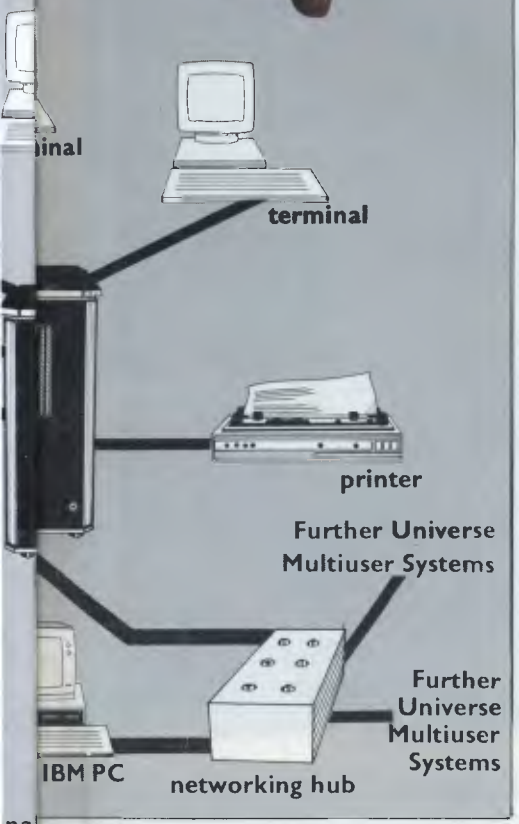
of a minicomputer.
reliability of a supermicro.

Smart
Powerful file I/O processor makes Universe operation faster, leaving the CPU free of repetitive tasks.

Fast
High speed (8MHz) dual processor design (80286 plus Z80H) with options for 68000, 16032 etc.

Durable
Ebony glass top and acrylic epoxy finish

Capacity
3 Winchesters plus removeable cartridge totalling up to 300 Megabytes total storage.



- ☐ Files may be automatically dated for future reference. Optional timestamping shows both creation and last access.
- ☐ Optional passwords on computers within a local area network.

Operating features

- ☐ Low cost serial terminals support both 16 bit (CP/M, Concurrent DOS, MP/M-86) and 8-bit (CP/M, MP/M II) software
- ☐ 200 character type-ahead buffer per terminal
- ☐ Fast 'hashed' directory searches
- ☐ A secure electronic mail facility. Optional electronic Telex.
- ☐ A multiuser appointment calendar
- ☐ Optional 8087 maths coprocessor
- ☐ Inter-terminal communication. Electronic mail is here!
- ☐ A programmable keys utility so users can redefine their keyboards
- ☐ Optional telecommunications with remote computers via modem

Full Field Support

We were the first company in Australia to introduce full 12 month on-site maintenance (now extendable to 2 years at time of purchase). All service and engineering support is carried out by AED directly.

Australia wide network

Field service is presently within 24 hours on the east coast and within 48 hours for country areas.

Our network is being aggressively expanded.

Inherent high reliability and modular construction minimize downtime and make service to the most remote locations feasible.

Customer support

Our very first system buyer is still a valued customer. We take special pride in supporting every existing customer and in providing the highest standard of service at every stage. As part of this support, the Universe is continually being refined in reponse to the needs of existing customers and Australian business.

AED

NSW: AED Computers (Sydney). Unit 3, Prospect Industrial Centre, 2 Stoddart Road, Prospect NSW 2149. Ph: (02) 636 7677. Telex: AA 70664

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WA: Computer Services of WA. 465 Canning Highway, Como 6152. PO Box 22 Como 6152. Ph: (09) 450 5888

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APC

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PORTA PAK COMPUTER

...other computers cringe

PortaPak comes with its sleeves rolled up. It was designed in Australia to get the most work done in the least time and at the lowest price.

If you want results, sheer computing power, trouble free performance, then PortaPak is the only choice. If you want prestige, if you need to stroke your corporate ego, we suggest you buy something else. Something that costs more, isn't as powerful but has a lot of "image."

Put PortaPak up against imported machines costing $5000, $6000 even $7000. The other machines cringe with embarrassment.

PortaPak has 800K of formatted space on each disk drive. The expensive machines which boast about having 360K suddenly look rather silly. With PortaPak you'll be able to handle much bigger data files and have far more programs on hand without having to fiddle around changing disks.

Reliability is often thought of in terms of machine breakdowns. Nowadays, the big problem isn't with breakdowns it's with hangups – when your machine turns out to be incompatible with your software. This is an enormous, widespread problem.

It's why we teamed up with Australia's software geniuses – Software Source Pty Ltd, the top suppliers of business and professional programs in the country. First, they specially customized PortaPak's operating system so it works with exceptional speed and simplicity.

Then they customized all their CP/M products to run perfectly on the PortaPak – products like dBASE II, SuperCalc, all the major languages, accounting systems, etc. Most importantly, they stake their reputation that all these products will work without hitches. No other computer in Australia can offer this total software support.

As for electrical and mechanical reliability, look inside a PortaPak. There's a striking difference. The PortaPak is completely modular. We didn't scrimp by putting all the circuits on one board. We use *three*. Servicing is simpler, quicker and cheaper. It's why the leading national computer service company, TCG Pty Ltd, is pleased to offer a 12 month service contract on PortaPak in all capital cities.

Take an extra close look at the Canon disk drives. If Rolls-Royce built computers, they'd use Canon drives. See the massive head protection shield? Hear the way the heads lock away every time they deselect? The designers had an unusual attitude to reliability – fanatical.

Now carry out some speed tests. On a standard benchmark test using BASIC routines*, the timings are: PortaPak 12.9 seconds, IBM PC 16.4 seconds, NEC APC 19.7 seconds and Sirius 16.4 seconds. Using a standard dBASE II routine**, the timings are: PortaPak 8 minutes 11 seconds, IBM PC 11m 52s, Sirius 17m 9s and NEC APC 19m 16s.

The expensive imports really cringe at this because they make so much of being "16-bit" machines. PortaPak is an 8-bit machine and proud of it. Not only is an 8-bit machine inherently better suited to jobs like word processing, accounting, spreadsheets, etc, but the 6MHz clock rate ensures it can run rings around the others even in complicated mathematical tasks.

Now to really rub it in, look at PortaPak's stunning additional features:

- Compact portability. It needs only half the desk space of its nearest rival. It goes with you on business trips, at night, on the weekend. *In one hand, you hold the concentrated working power of an entire office.*
- 9-inch screen, 80-characters wide but with 35 lines instead of 24. You see more of your work and the characters are the normal shape – not elongated. Much more readable.
- 640 x 304 high resolution, dot addressable graphics.
- Free software including Spellbinder word processing and office management system (the most powerful available), EBASIC compiler, MENU to make life easy for new users, MODEM for telephone communications, and Speed Print which lets you continue working while you're printing.
- Universal terminal emulation lets your PortaPak mimic the screen handling of other computers and run the programs installed for them. Your PortaPak can act as a terminal for any computer you care to name.
- Ability to read and write to other 5.25-inch disk formats – e.g. Kaypro and Obsorne. Lets you exchange software directly with owners of different computers.
- User definable character set lets you work with foreign alphabets, scientific symbols, etc.
- Five input/output ports for connecting to printers, modems, etc.
- Wide range of peripherals including 5 and 10 Mbyte hard disks, built-in world modem, RAM drive, EPROM programmer, A/D converter, etc.

Radically different, distinctly Australian design using industry standard software.

Two one-megabyte disk drives – total formatted capacity = 1.6Mb.

Z80B processor running at six megabertz.

9-inch screen, 80 characters by 35 lines 640 x 304 graphics.

Intelligent, capacitive, spill-proof keyboard.

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For the name of your nearest PortaPak dealer contact:
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Phone (02) 661 4877. Telex AA71063

*See Australian Personal Computer, Feb., 1984.
**See Australian Micro Computerworld, Nov., 1983.

THE PORTABLE COMPUTER CO.

Investigative journalism courtesy of APC's roving reporters.

Castles in the air

Bets are being taken inside Commodore and Atari as to which of them will be first with a super-duper 68000 system to beat the Macintosh. Outside those companies, most money in the trade is going on Atari. This is due to Jack Tramiel and his remarkable publicity campaign.

The difference between Commodore under Tramiel and Commodore today was revealed most emphatically by the contortions of Atari, where Jack Tramiel is now in charge, last month. While Tramiel was on television showing his new ST500 and proclaiming that it would be announced at Hanover, plus joining in with Digital Research in announcing GEM software developments, Commodore was keeping quiet.

Then, two weeks later, it produced the PC clone, the model 10, ready for shipment in April. 'We have them in the warehouse now', Commodore said.

As little as two months ago I was shaking my head and wagging my beard and saying that I didn't think it would be launched. OK, it may not be the right time to do anything as ho-hum as launch a PC clone, but Commodore has launched it. Staff there have painful memories of previous non-launches and are determined to avoid over-hyping new products as much as possible.

So: what of the Commodore Amiga?

Like the Atari, it has a 68000 inside it. Unlike the Atari, it also has extra hardware, with special chips to draw lines, file areas, compare memory blocks, and do a hundred odd little things that, in the Mac and the Atari, the central processor has to devote its whole attention to.

My contacts in the States are very excited about it because of the power it gives them to invent totally convincing games which run a lot faster than anything they have ever dreamed of in the 8-bit world. And they tell me Commodore is shipping advance models for software development to programmers.

In contrast, Atari is talking to the right people and convincing them that the ST is on the way, but isn't giving computers to software people. On the contrary — if you want the Atari you will find that the company is offering to relieve you of a tidy four thousand dollars for the documentation, without which you cannot write a byte of code.

Commodore people aren't to be drawn on when the Amiga will be available, but they have their own opinions on when the Atari ST will be out and they aren't expecting it this year. It has to be said that, on track record, nothing in Tramiel's history convinces me that they are wrong. I've written too many stories about Commodore vapourware which refused to condense into products, or which took two years longer than predicted to appear. Jack Tramiel has the reputation of being the only person in the industry who could possibly get the 'Macbasher' or 'Jackintosh' out by April, but no-one seriously expects this to happen. He also has the reputation of tailoring his promises to his listeners' desires, rather than to possibility.

Guy Kewney

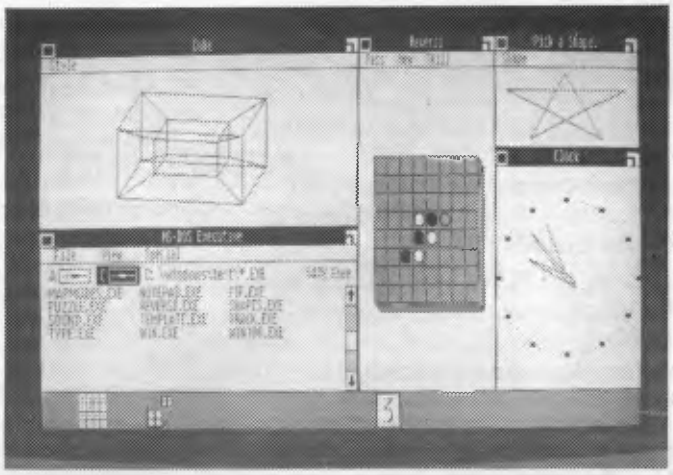
Wimps prepare to go on the warpath

The wimps are prepared for a big show-down this May, if Digital Research and Microsoft are to be believed.

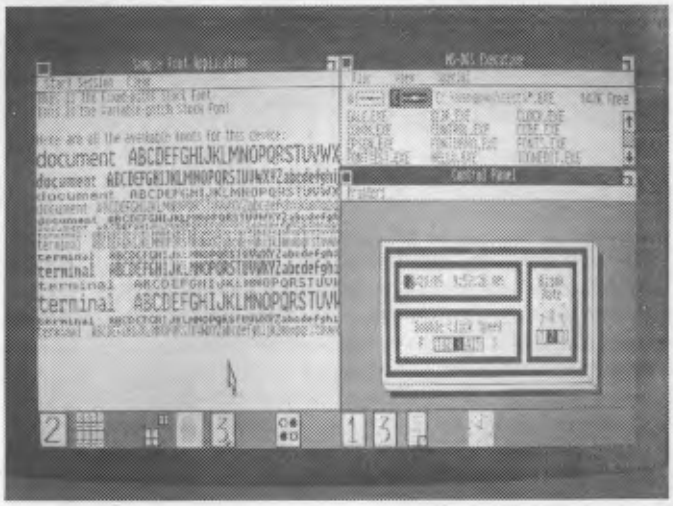
Senior wimp (Windowing Integrated Mouse Program) Microsoft Windows is now, after a gestation period an African elephant would baulk at, finished, and is scheduled to hit the streets in late May/early June. DR's GEM, according to vice president Paul Bailey, is running on the Atari 130ST and 520ST machines, which are promised for May.

Versions of MS Windows have been around for more than a year now, but the final specification wasn't ready until the middle of last month. According to Microsoft, it will run with all existing applications software.

GEM will differ from Windows in that it will run on 68000 machines as well as on the Intel family. Normally the 68000 version will run alongside CP/M-68k, but in the case of the Ataris it has been interfaced with a modified version of 68k to form the TOS (Tramiel Operating System).



MS Windows — opening in May



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Open Access. As for DEC Rainbow. **$795**

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DECmate III Wordprocessor. Fully integrated WP including WPS-8 software. Outstanding performance and value. **$3,920**

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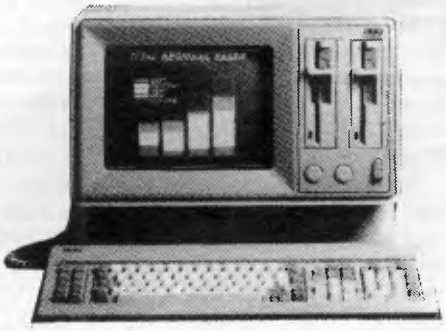
IBM PC Super Compatibles

Logitec PC 1603. 256K, 3 disc drives inc. 80 track (hard disk optional), monitor, plus software to read and write over 150 disc formats (including Apple II). Six months warranty from Hills. **$4,750**



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Glover & Assoc.

This is Cipher Data Products' tape backup system for IBM PCs and workalikes. The 25Mb system is based on a ¼ inch cartridge tape drive and uses a standard floppy disk interface so it responds "to floppy disk-like commands". The system also features file-oriented, rather than image-oriented, backup so that users can back up specific files or directories as well as the entire disk. According to Cipher, this eliminates problems faced by image-oriented systems when a winchester drive fails and is replaced by a drive with a different bad-sector map.

File-oriented backup also allows users to selectively restore files or directories from the last backup copy rather than having to restore the entire backup copy and wipe out current files that are still intact.

The 5210 system can back up two entire IBM 10Mb hard disks or one 20Mb hard disk at approximately one minute per Mb on a single standard ¼ inch tape cartridge.

Don't hold your breath

Olivetti is not, after all, immune to error in the micro business, and its latest dealings with American telephone company AT&T provide a sobering illustration of this.

As confidently predicted in this column, the AT&T rival to the IBM PC, like the ITT rival, has turned out to be a megaflop. However, the reasons turn out to include something like the standard amount of computer industry blundering. From America comes a complaint by a well-known software house that the Olivetti/AT&T machine doesn't work. The company, Micro Data Base Systems, is known for having produced one of the most powerful (and intractable) database managers for any micro, MDBS3.

There was going to be a version of that product for the Olivetti/AT&T machine, and it has been suspended 'because of the unreliability of the hardware, and the operating system.'

However, industry sources are still optimistic, pinning their faith in the hope of a version working on the IBM At but running under Xenix, Microsoft's version of Unix.

For me, optimism based on Unix is misplaced optimism, but I'm pleased to be able to record it so that we can look back with hindsight in a year's time. AT&T is placing its future trust on its 7300 personal micro, which looks like a Macintosh, but runs Unix software.

That machine uses the 68000 processor, a close relative to the one inside the Macintosh, but don't run away with the idea that programs will need relatively little conversion from Mac to Bell.

Most programs written for the Mac don't address the chip but use the high-level routines built into the Macintosh by Apple. Unless AT&T produces an emulator of the window manager, there is going to be a whole host of nothing to run on the 7300 for a long time. Except, of course, for the possibility of converting Xenix applications — and despite the theory that Xenix is very like Unix, that won't be the work of a couple of weeks, either.

Guy Kewney

A cold volcano

Still optimistic about Unix, two companies, Cifer and Sphinx, have recently made revealing announcements.

Cifer, a company which had a rough year in 1984 has had to fire 89 people out of 224, close down one of its plants, and work out a new financing plan, mainly because it put its trust in Unix, and Unix has so far failed to make it rich.

Cifer has a profitable main business, making terminals for the data processing professional world. This looks likely to keep it going while it waits for the world to come around to Unix. According to Sphinx, a company which specialises in Unix (training, seminars, conferences and support), this point may at last have been reached.

Pamela Geisler, managing director of the company and a firm protagonist of the programmer-friendly (but, I'm afraid, user-proof) operating system, reports that 'orders for Xenix for PC products are a substantial part of Sphinx software sales', and that this 'is expected to continue in 1985, spurred on by IBM's announcement of Xenix for multi-user versions of the PC/AT'.

It's good, encouraging stuff, spoiled only marginally by Pamela's own description of the Unix market as a bit like 'sitting on a cold volcano'.

Guy Kewney

Corporate Trio

A program which can take ordinary ASCII codes (as supplied by most mainframe dial-up computers) and turn it into files for Lotus 1-2-3 or dBaseII and dBaseIII, is of such obvious utility that the only real surprise is how few there are.

A new one, Trio, from CDI Systems of Oak Brook, Illinois 60521, USA, costs a whopping $US395, a price which reflects a simple fact of life — that most buyers will be corporate data processing professionals.

Trio's main function is the job of transferring files between PCs and mainframes, and the data conversion routines are a new add-on. But it's almost a case where the add-on is worth more than the original package.

Details on (312) 325 2430 in the USA.

Guy Kewney

Taking over

To my surprise, Americans are now taking very seriously the idea that the IBM PC Two, when it comes, will use a non-standard diskette of 3¼in diameter. This was the size chosen by Dysan for its bold attempt to take over the disk world by producing Apple-compatible 3¼in drives, disks and software which no one wanted.

It seems unlikely, perhaps, that IBM might now want to

adopt the same standard, but there are two possibly plausible arguments in favour. First, there must be quite a few disks lying around at a nice price. And second, by going that route, IBM would get software onto a format which no one else could copy, so lookalike machines would be handicapped until they could catch up.

The chip inside the Two is looking more and more like the 80286 with which IBM would do very well. It would make the machine around three times faster than the PC, and it is known to be very much prettier, with a footprint the size of the Junior's.

All we really want to know is 'when?', and of course, IBM isn't going to help us with that.
Guy Kewney

Warming up

One of the most impressive word processors I've played with in some time is Microsoft's Word on the Macintosh, which will be reviewed next month. Anyone starting from scratch but anticipating that word processing will be their major activity should give this one a half-hour trial at least.

It is, like all Macintosh programs, entirely different from the version on the ordinary, user-proof previous generation machines, and the only thing it loses by the trade-off is WordStar function keys.

If I knew why computer designers won't give WordStar-trained people the old familiar control-key operations which we can all do in our sleep, I'd rest easier at night. Why is 'cut text' CONTROL-X, 'copy text' CONTROL-C, and 'paste text' CONTROL-V? All my computer life (well, sort of) CONTROL X has meant cursor down, and CONTROL C, page down.

The original answer, of course, was that 'Macintosh doesn't use cursor keys'. No, it doesn't, and don't ask me why not. The CONTROL key is there, and my reflexes are there. But Apple didn't invent WordStar keys, so we aren't allowed to use them.

The menu for character formats is CONTROL D. The menu for paragraph formats is, logically enough, CONTROL-M. Logically? No, of course it isn't: it's completely ridiculous.

If Microsoft/Apple had to invent a whole new set of control-key standards, what was wrong with a logical set? Why not a mnemonic set? Aargh!
Guy Kewney

The thinking man's software

Brainstorm, which was designed as an aid to thinking, has a sort-of rival in Think Tank, which has now appeared in a version for the 512k Macintosh.

Brainstorm still has the edge over Think Tank in one important respect — it links ideas in the outline, so that your idea model can have the same thought in two places and the system will link them together. The result is that Brainstorm can be used as a powerful indexing tool.

Think Tank, however, on the Macintosh, takes advantage of the obvious theory that the second step after a good deal of complex thinking is normally a good deal of heavy writing.

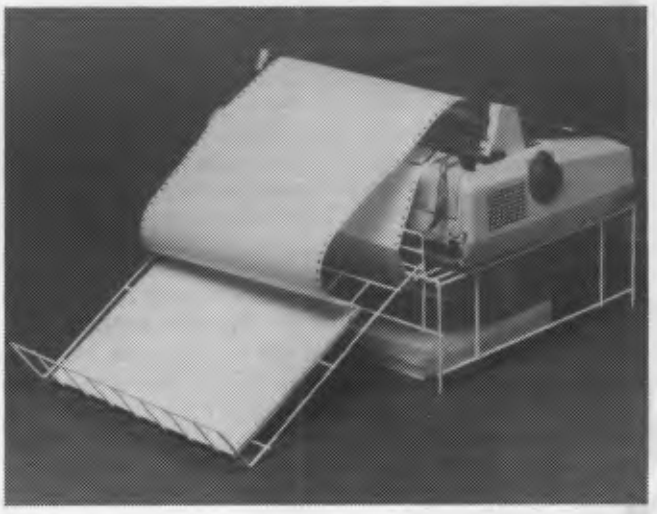
Having set up your 'outline' in Think Tank, all the headings and subheadings can be viewed as the 'title' of a window, and that window can be up to 16k long. On Brainstorm, you have to print your processor out and try to work from the blueprint that gives you, which isn't as powerful as the linked idea display on the computer, at all.

For a writer, Think Tank 512 is like working on a book with the entire structure always visible to you as you write. At any stage, you can close down one window and go back to a previous chapter to add a thought (or page, or whatever) which has just occurred to you.

As word processors go, it's OK, but limited by comparison with Macintosh processors. It gives you two sizes of type, and a rigidly-defined set of heading and footing options — but then, what other word processor will print out the contents page with numbers?

Coming soon — a version of Think Tank for IBM users, version 2. This will include the fascinating idea of 'clone' subjects and involves taking the 'replicate' idea of spreadsheets and perverting it. Take a sequence of ideas and sub-ideas, for example called 'product development', and 'clone' them; you can then put clones into the outline for all the products you're planning.

Change one, and all the other clones will be changed too. Apparently, this neat feature was an accident — it was meant to be just a duplicate function, but the link-back happened as a program bug. When the company fixed it, the test users complained that they'd liked it, it was the best thing in the package . . .
Guy Kewney



People with 136 column printers (using 15 inch wide paper) can now make use of the Paper Tamer in its broadened version. It's a device to store up to 900 sheets of continuous paper under the printer and collect the printout in a catcher tray. RRP is $50 for the 80 column version and $60 for the 136 column model.

The proof's in the running

Minicomputer builder DEC has a bone to pick with micro maker Intel: apparently Intel has been telling fibs about how fast its micros are, compared with DEC's minis.

In 1981, an American magazine *(Byte)* apparently printed a Benchmark which Intel picked to illustrate the power of its System 86/330. When Intel ran the Benchmarks in 1982, it said that its system was 'clearly superior to the LSI-11 on this Benchmark. The LSI-11 is DEC's micro version of its PDP mini.

Also available: IBM PC key boards, multifunction memory boards and Modems.

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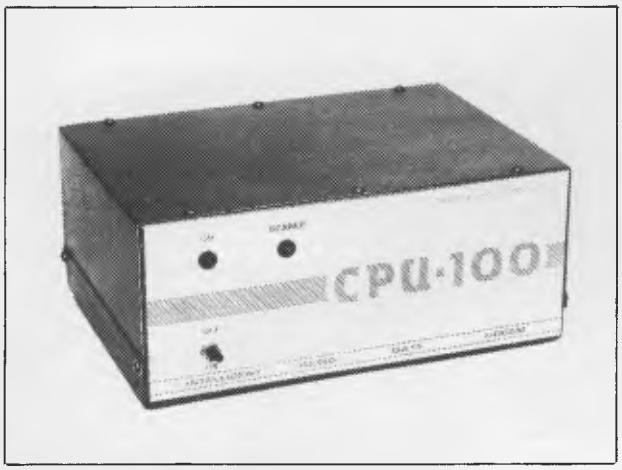
Digital has now run the Benchmark and finds that 'on the contrary, just the opposite is true — both the LSI-11/2 and 11/23 executed the Benchmark faster and required less memory than the System 86/330'.

All good fun. What I found fascinating was the fact that this (Pascal) Benchmark was tried out on 20 different combinations of machine and compiler, the fastest being the PDP-11.70, a powerful mini, with NBS Pascal. That took 2.6 seconds, compared with the Intel system's 9.20 seconds. The best 8-bit system was a Z80 with MT+ Pascal, taking 19 seconds.

No, that isn't the amusing bit. The amusing bit is the time taken by the Apple II with UCSD Pascal. It took 516 seconds . . .



This ordinary looking box contains an "intelligent radio data modem" called the CPU-100. It has the interesting ability to interface a remote terminal and computer via the airwaves so that the two can communicate as though they were directly wired together. There's also an amateur radio version which provides users with a range of options including the reception of Baudot RTTY and ASCII. Call GFS on (03) 873 3777 for more details.

Anyone for second place?

The irony of the collapse of Peachtree, the micro subsidiary of the world's biggest software house (MSA) is that only the Peachtree Business Management System has been bought out.

Dick Moore, managing director of Peachtree, is now managing director of his own company, Plusmark, which bought the rights. Good luck to him in turning the 1000-odd Peachtree customers into Plusmark customers and building on the enhancements which they plan, but really, we could have done without yet another 'we'll take over the world' comment on the way.

'It is our intention to establish Plusmark as the market leaders in specific vertical areas,' he said. Funny no-one you talk to ever plans to come second, third, fourth, fifth or whatever, and yet out of the hundred or so people in any business, only one can be the leader. And then the 99 get annoyed with you for suggesting that they're indulging in hype.

Guy Kewney

Exercising a prerogative

Adam Osborne has spoiled the fun of reading his book, *Hypergrowth*, by announcing that even he no longer believes the sensational mystery in it.

His book was an expensive piece of research designed to illustrate the possibility that the collapse of Osborne Computer was engineered by one man — the man he hired at a million dollars per year to run it — Robert Jaunich.

He now tells me he's changed his mind.

'Evidence coming out in the depositions concerning the collapse has shown that two of the bits of evidence which led me to suppose that Jaunich was the instigator of some of the strange events are not evidence pointing to Jaunich at all,' said Adam. 'It seems that one was a letter from the financial backers, which he was obliged to sign, and the other was something he had nothing to do with.'

West Coast gossip suggests that Adam's opinions may not have changed as much as he publicly says. 'There was almost certainly a mega-lawsuit in the pipeline,' says John Dvorak, co-author of the book and, by his own claim, the person who 'toned down' many of Adam's more outrageous allegations in it.

In the book, Adam says that if Jaunich were not acting out of malice, then he must have been incredibly stupid. Adam refused to be drawn on his own opinions of Jaunich's stupidity now that he officially believes in his innocence of all malice.

His new venture, Paperback Software, is flourishing sufficiently for him to have hired 12 staff, and to have signed contracts for two of his programs with hardware suppliers who will bundle them in with their products. The products are Executive Writer, normally selling for $US70, and Number Works, a $US40 VisiCalc-style product, and they'll be supplied with upgrades for the PC Junior, by Tecmar.

Guy Kewney

Jumping the gun

Panic warnings that IBM was planning a huge announcement of a new micro turned out to be misguided when the company released details of its biggest range of commercial mainframes, code-named Sierra, instead.

But no one is laughing about the idea of seeing the PC displaced in the company's affections any more. The PC Two is becoming a stronger and stronger series of leaks, and it could easily happen (in the States, at least) before the third quarter. What looks more likely to happen here is that the Junior may be announced.

The arguments against it, say my sources, are that it isn't profitable to built at the price ($US800 or so) that it needs to be cut to, to sell. From what little I know about IBM's production line technology, it would be profitable at $US600 and worth making at $US500, so I don't buy that theory.

But the other argument against the Junior is that the Two will make it obsolete. It would do that if the Two used a substantially bigger chip, either the 80186, or even the 80286, as in the PC/AT. And my sources suggest that either or both these chips are indeed the ones that form the heart of the next range of IBM micros. The fact that IBM has launched the JX computer in Japan, with the forecast 3½in Sony disk instead of current 5¼in

technology, leads many to believe that this is the way the future goes. Rumours of big changes in orders to disk drive makers suggest the same thing.

My own money is on an 80186 family, since the 80286 is still not available in very high volumes or at very low prices. But, if IBM waits until after October, that may become irrelevant.
Guy Kewney

As good as new

You may have trouble finding a buyer for that old Apple, or sub-standard SuperBrain, or slightly dented Osborne, or less than new Kaypro, or original VZ-200, or whichever used computer you currently want to swap for a shiny new Plus/4.

It isn't because no-one wants to buy them — it's that you'll have trouble finding a buyer. Apart from feeble attempts by micro magazines to establish 'trading posts' in their pages, I don't recall seeing anyone who is organising second-hand computers on a national basis.

But this could all change, if plans currently being worked on by Fred Brown come to fulfilment. Brown was the man who was made famous in Adam Osborne's book, *Hypergrowth* (which described the rise and fall of Osborne Computer), by trying to save the company. He found a cash buyer for all the old stock — $16 million worth of Osborne 1 machines.

This talent for moving old stock still remains with him in his new venture, *The Brown Book*, a trade guide to used computer prices. The book gives full details of a wide variety of computers on the market, from pixel count to disk capacity, to byte size, to the type of chips used in memory, plus three prices for each computer. It shows the recommended retail price, the actual 'street' price which everyone is paying, and the typical 'used machine in good order' price.

'Right now, there is something like $US300m worth of excess inventory piling up in the US', Brown told me, 'from people like Eagle, Televideo, Commodore, Fortune, and a variety of others. Everyone built machines for this tremendous growth pattern, and it's stalled. And the reason is that people who want the new machines can't "Trade up" from their old equipment the way they can with cars.'

The book costs a thumping $375, but that's a subscription for six quarterly issues.

We don't know of any plans for an Australian edition to-date, so anyone keen to work on this project should contact him on (805) 687 1140 in Santa Barbara, California, or write to PO Box 3490, Santa Barbara, Ca 93130.
Guy Kewney

Slave watching — a media pastime

Two interesting developments occurred in the last month related to the PC Slave (a product to allow many users access to the data and peripherals of one IBM PC).

The first is that it is to be manufactured in Australia by Alloy Computer Products along with a range of disk drives and tape back-ups. Based on the comments of the president of Alloy in the US, "As our products are virtually pure technology, it is a lot cheaper for the end-user if we ship ideas rather than hardware", this local manufacture will expectedly eventually result in a price reduction of Alloy's products in Australia.

One of the first products off the local manufacturing line will be Version 2.0 of the PC Slave which will support colour screens — so in the future you might have up to 30 users screaming around the wild blue yonder (the PC Slave's cpu operates at a much faster speed than the bog standard IBM, so the Flight Simulator simulates more a fighter jet than a small single engine propeller aircraft).

The second PC Slave development is a press release from Archives Computers who are also distributing the product in Australia much to the chagrin of Alloy Computer Products (Australia). There's been a fair amount of flak going back and forth between the companies as to who has the rights to the PC Slave in Australia, so the inclusion in the press release of a copy of a telex from the president of Alloy in the US stating that both Archives Computers and Alloy Computer Products have the right to sell the PC Slave product range in Australia should, but probably won't, settle the argument forever.

Gower Smith, MD of Archives, was obviously very pleased with the telex: "The recently reported claims by Data Design (Alloy Australia) about their exclusive right to distribute the PC Slave here were blatantly incorrect, and the telexes received from the two manufacturers are conclusive evidence that Data Designs' legal threats are totally without substance. We are now considering whether a defamation action is justified", he said.

If any of this is of interest to you, you'll probably find a report of another volley of accusations etc between Archives and Alloy Australia in these pages in the near future.

Is this a new touch-typing training accessory, or just a keyboard for people with very thin hands (who don't need touch-type training) or just a new way to catch your fingers underneath the desk? Or none of the above?

Full marks if you chose the last alternative. It's actually a time delay photograph of the "Drop-n-Hide Keyboard Slide" — a space saving piece of furniture for very small offices. Details (including a schematic of its inner workings) on (07) 832 4900.

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4th APC Show

At the official opening, Mr Eric Bedford the Minister for Industry and Decentralization and *the Minister for Small Business and Technology is concerned about our international competitiveness in manufacturing.*

If you had to compare this year's Sydney Australian Personal Computer Show to the same event last year, the most outstanding difference is the lack of it. The personal computer industry is maturing; it's becoming steadier and more like any other established business. The heady days of major new products being released monthly, if not weekly, are gone and largely replaced by corporations adhering to traditional manufacturing and marketing strategies. So it is no surprise that this year's Show looked more like last year's Show than last year's looked like the year's before. This is all probably by way of a subconscious gripe from a journalist who's "sensations" resources are being eroded in the PC industry. The trend is also bad news for some non-journalists. The PC industry used to be terrific for lawyers: bankruptcies were more popular than Saturday's football match. And programmers benefited too — trying to fix-up the mess created by some cowboys posing as computer suppliers.

The beneficiaries of the new-look PC industry are obviously the public. The rate of technical innovation is decreasing (or perhaps, more accurately, its application in commercial products is decreasing) and is being replaced by staunch reliability.

This description applies to a range of new products at the Show including the Commodore PC, another IBM PC workalike but this time from the home computer king. Epson put its mini lapheld in a glass box (again not technically innovative but based on proven technology) and wouldn't let anybody touch. That's except us — see a Benchtest elsewhere in this issue. Tandy, which grew up in the home computer market and has to-date had more success in the business market than Commodore, had another IBM PC compatible at the Show. And to prove just how compatible it is, Microsoft's Flight Simulator was running on the machines in demonstration mode. It didn't take long to work out why it was in demonstration mode (it wasn't the convenience of having something happening on screen all the time): take a test flight on the Tandy machine and you'll likely not stay airborne for long — the function keys are in a most un-IBM PC compatible position making it more than easy to hit "full flaps" when all you wanted were a few more revs from the engine. Ah, well . . .

An interesting but irrelevant product award could have been dished out to a peculiar device you've probably up until now only seen on video clips: a cross between a keyboard synthesiser and a guitar. The most annoying product/feature award could have gone to another of those "robots" that wander around making inane comments; are always closely followed by someone with an over-the-shoulder bag and a bad cough; and cause Opposition Leaders embarrassment when they realise it's not for real.

"Worst Stand" awards weren't given at the Show, nor were ones for "Questionable Gimmicks" (Imagineering would have won this for its pianola:

The award-winning Digital Equipment stand before the visitors got to it.

"You see we're launching Jazz and are selling Symphony, don't cha geddit?") but Tallgrass Technologies and Digital Equipment deservedly got awards for excellent stand design and presentation.

About 23,000 people attended the Show, a number the exhibitors applauded as sufficient, not excessive. Without doubt the Show was a more pleasant, less rushed and crowded, more sane and entirely more productive affair according to both visitors and exhibitors. Once again *APC* congratulates the organiser, Australian Exhibition Services, for producing what is recognised as Australia's premier personal computer event, for producing a show that so accurately reflects the direction of the personal computer industry; and simply for producing the Show so well.

PC85 — The Conference

Steve Withers attended last month's Personal Computer Conference which ran concurrently with the 4th Australian Personal Computer Show.

This year's Australian Personal Computer Conference showed a marked change in emphasis. Being organised by the NSW branch of the Australian Computer Society (despite the name there is no direct association with this magazine) the PC Conferences are concerned with the "serious" side of personal computing. The change in 1985 was the attention given to the use of PCs in large organisations — more precisely, the management of personal computing as a corporate resource. The impression I gained was that managers who haven't already purchased a personal computer are likely to walk into work one morning to find micros sitting on their desks. An exaggeration perhaps, but that's the way some companies seem to be heading.

There seemed to be broad agreement on two subjects: networking and applications software. Networking is generally favoured over multi-user systems, and in some parts of the industry the term "multi-user" is being used to describe networked PCs rather than its traditional implication of timesharing (which term has been hijacked by those trying to sell us part ownership of a holiday flat). Microsoft has a foot in both camps with Xenix and MS-DOS 3.1, but its president,

Herbie Briggs has just destroyed the myth that all floppy discs are created equal.

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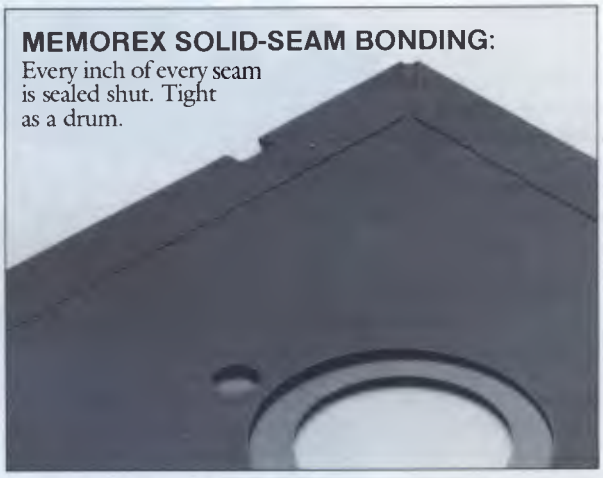

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Jon Shirley, stated that the company estimated that multi-user systems (of the traditional type) would never exceed 10% of the microcomputer market. For what it's worth, I've always felt that PCs became popular because of their software, and we would never have seen that kind of software developed for multi-user machines. Ever used a spreadsheet on a mainframe? I've seen one, but I would never use it while I've got a micro around.

One especially interesting observation was that the probability of a micro failing increases massively following a repair!

In the applications software arena the hot topic was integrated versus integrating software. Dennis Carelli of Software Publishing Corporation (the "pfs" people) spoke on this subject, but it was mentioned in several presentations. According to Carelli, there are three kinds of integration. The "all-in-one" approach is embodied by Symphony — a big, relatively expensive package, but one with very close coupling between the various functions. The disadvantages are that any particular user may be forced to buy more functions than he or she really wants, and the package may require extra hardware. "Component integration" overcomes these objections by allowing users to buy separate programs for the individual functions. These programs are designed to exchange data and have a common user interface, but the integration may not be as tight as in the "all-in-one" packages. The third method is to write programs for use in an integrating environment like IBM's Topview or Microsoft's Windows. Carelli's opinion is that this approach is the one most likely to succeed as users will be able to choose programs that meet their needs from packages offered by a range of producers, and because it will be possible to upgrade individual applications at will, either to take advantage of new products or simply because the user has become more sophisticated. With regard to user sophistication, Jon Shirley had earlier pointed out that Microsoft don't produce integrated ("all-in-one") software as most users need a high power central function, and you can't produce an integrated package without compromise. This remark made me think of Lotus 1-2-3 attempts to produce pie charts.

David Angeloro gave a very enlightening talk on the issues of security and protection of microcomputer systems. His message was that one "can make PCs as secure as mainframes", and gave many practical suggestions towards achieving this end. One especially interesting observation was that the probability of a micro failing increases massively following a repair! This he said is because too many technicians fail to take even the simplest precautions against damage by static electricity.

Les Bell lived up to his usual high standard while discussing "the real issues" in the selection of personal computers. If everyone who stands up to speak at a conference were as articulate and familiar with their subject as Les, it would be a marked change for the better. The issues, by the way, were ergonomic considerations, technical aspects (like speed and capacity), and things like vendor support and quality of construction.

A handful of speakers described their companies experience of the introduction of personal computers. It seems that the pioneers who went out and bought a *PC* have had a significant impact on the computing practices of many companies and there is now a considerable degree of central direction of personal computing.

One session was pure entertainment. According to the conference programme, M Conway Portingale, Vice President of Systems Development, AT&T International was to speak on the "Clash of the Giants: AT&T and the World Market". At the end of a very amusing speech it was revealed that the speaker was Cambell McComas who makes his living by posing as doctors and other professionals. He does it very well, and generally manages to convince at least part of his audience that he is the real thing. Some of the questions from the floor suggested that he succeeded at the Conference.

TI's Pro Lite makes its Australian debut.

Behind the foliage and people is one of the Show's highlights: Telecom's ComputerPhone.

The final Conference activity was a panel session, giving the overseas speakers a chance to discuss issues suggested by delegates. Given the makeup of the panel, the discussion was very one-sided. Those delegates who left early (about a third by my estimation) didn't miss much. About the only controversy was the "Mac versus IBM" issue.

I've not covered all the speakers, but I have tried to give the flavour of the conference. Will I be going next year? Sure — the conference may have its faults, but it is *the* Australian Personal Computer Conference. Where else can I meet people who do a similar job, or talk to senior representatives of the companies with whom I deal as a customer? Even if just 50% of the speakers deal with matters relevant to my work, it is still well worth attending.

Commodore's super large '16.

Confession time: I too dismissed the Apple laser printer with a yawn when first told about it. 'It uses the same laser engine as the Hewlett-Packard but costs $US7000 instead of $US3400,' was an obvious end-of-argument observation.

It isn't like that.

Two things about the latest Macintosh industry announcements from Apple — the 'work group' network, and the printer — make it look, to me, like a very powerful plus for the machine. Firstly, the printer is so good that it makes the Hewlett-Packard (HP) look like a clumsy dot matrix attempt to imitate a typewriter. If this worked, it would still be pretty awful because typewriters aren't all that special.

The Apple printer is nearly print-works quality. Many people will use it for typsetting, and their customers won't know it.

At $US7000, however, that would be the end of it, except that, should you be a Mac user, you will covet it. It will occur to you, very quickly, that if your colleague in the next office had one, you could share the printer and it would be down to the cost of the HP. And if you both have one, and could talk your other colleagues in the group into buying Macs, then the printer would cost . . . hmm, $US7000 divided by eight . . .

Here's a shot of the output of this printer, actual size, and then enlarged, just to show how accurate and smart it is.

Apple's net, Apple Talk, is not a local area net. It's a way of passing files from one Mac user to another, of sharing things like disks, and, of course, the printer.

By the end of the year, the company reckons that it will have a plug-in card for the IBM PC ready. This will connect an Apple Talk group of workers into the PC Net of the official computer network in a company, thus saving the face of the data processing executives who oppose 'rival, incompatible' standards springing up. The whole Apple Talk net will look just like another node on the main net.

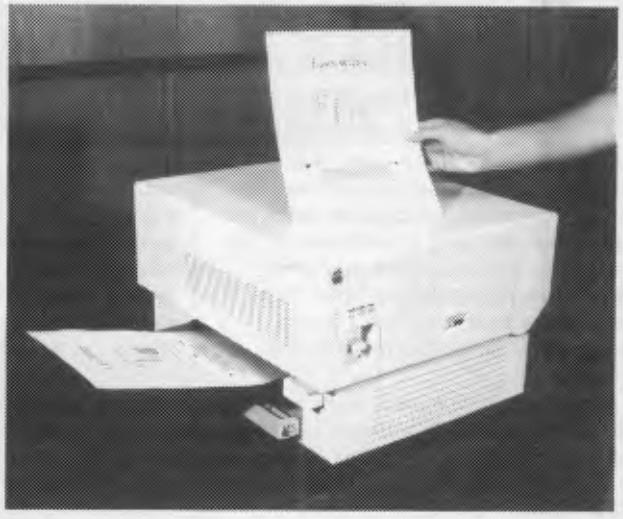
The question which still needs to be answered is simple. What software is there that runs on the Apple Talk net? At this stage, virtually nothing. No one at the Cupertino launch could agree on any one version of how much software you got with your $US50 network connection, if any. John Sculley (not in a good mood) said 'lots' and 'none' to shareholders in consecutive paragraphs of a press briefing the day after the launch.

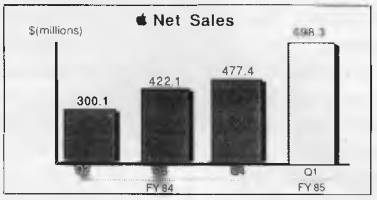
That's nothing special. There is virtually no software, or any net, that can really cope with the power that the net could make possible. For example, even on an old network like Nester's Plan 4000, you can't have two people editing the same document — it's theoretically possible, but no one has done it.

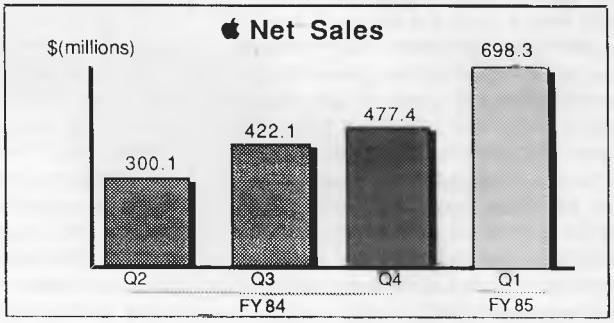
But Lotus' Jazz, when it arrives, will make limited use of the Talk net and will soon be expanded to make full use of it. Other programs were demonstrated, such as a multi-machine database, which already works on trial sites of Apple Talk, and a typesetting machine from Linotype is also available.

For the technical, the printer is 'the most powerful computer Apple has ever launched,' according to Steve Jobs, Apple founder and chairman. 'It has a 68000 processor running very fast, with half a megabyte of read-only memory and 1.5Mbytes of RAM,' he said, and it uses a 'resolution-independent graphics language developed by Adobe Systems, called Post Script.'

The thing is a knockout, and it has to be. The advertising





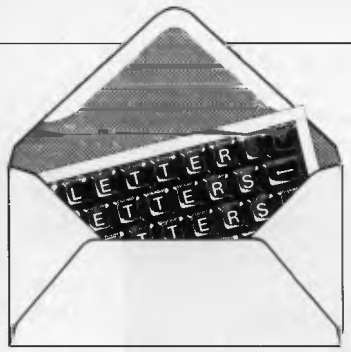


campaign chosen by Apple shows a long line of grey-suited executives, blindfolds over their eyes, marching relentlessly over a cliff, one following another. At least, says the commentary, look into the alternative.

A neat idea, but hopelessly wrong for corporate America, who to a man/woman reacted negatively. 'I personally found that very insulting, said a far from conservative computer hacker who happens to be in charge of data processing for a large pharmaceutical company. 'And I know that other people doing this sort of job, who have bought IBM PCs, feel very much the same way.'

Apple will have to hope that its subversive tactics work, and that departments who want to share the printer will buy its hardware without consulting the official authorities. The authorities are not eager to be won over.

Guy Kewney



LETTERS

This is the chance to air your views — mail to 'Letters', Australian Personal Computer, 77 Glenhuntly Road, Elwood, Victoria 3184. Please be as brief as possible and add 'not for publication' if your letter is to be kept private.

Yahtzee dice loaded!

With reference to Tumbling Dice by Ron Roberts in the November issue of *APC* I became suspicious of its "fairness" when Yahtzees with ones or sixes seemed almost impossible. Testing the random number expression used [R=INT(RND(1)*5+1.3] I found the probability of getting a one or a six half the probability of getting either 2, 3, 4 or 5. The following program verifies this claim:

```
 10  DIM N(6)
 20  FOR I=1 TO 6 :
     N(I)=0 : NEXT I
 30  PRINT
 40  FOR I=1 TO 1000
 50  R=INT (5*RND(1)
     +1.5)
 60  N(R)=N(R) + 1
 70  NEXT I
 80  FOR T=1 TO 6
 90  PRINT T "---" N(T)
100  NEXT
```

May I suggest the more correct formula R=INT(6*RND(1)+1) for a fair game.

W Holland

Each to his own

With reference to your Benchtest of the Sharp MZ-5600 (February, 1985), I would like to take issue with a comment made by the reviewer.

In the opening paragraphs of the article, the reviewer states that he is puzzled by 'the thinking behind the choice of outdated CP/M-86 and a non-IBM PC compatible implementation of MS-DOS'.

This reminds me of the early days of microcomputing when quite a few of the 'uninformed' were convinced that if it wasn't TRS-80 compatible, it was antiquated.

IBM-DOS has been through as many as three versions, none totally compatible with the other. After Digital Research stuck out so long for compatibility and achieved a *de facto* standard with CP/M-80, it became necessary to bring out an operating system for the 16-bit world. CP/M-86 was born, and the level of compatibility with the old CP/M-80 is *very* high. This has led to a large amount of software becoming available for CP/M-86 in a very short amount of time. Wonderful — then along came MS-DOS; the differences between the operating systems being quite trivial, yet enough to make programs for CP/M-86 incompatible with MS-DOS — *to no advantage*. Shortly after, Version 2 of MS-DOS arrived, which is not even fully compatible with the first.

The IBM name carries a lot of weight and many have copied the machine (as many copied the TRS-80), and if you want to rip off someone's software, then the compatibility between different machines makes that easy. But if you want a fast, efficient computer with decent graphics, then the IBM PC is very slow and the graphics are *very average*. MS-DOS 1 permanently damages files with the greatest of ease, while its successor, MS-DOS II, is actually slower (in implementations I have seen) than the first version. I would argue that the rush for compatibility has slowed down progress in the 16-bit world by an intolerable amount.

Take a look at the Zenith Z100, an 8/16-bit machine, *totally* compatible with both CP/M-80 and CP/M-86 *simultaneously*, as well as (if you must) a 'kind' of MS-DOS. There are other examples of fast, efficient, cost-effective machines: the Sharp MZ-5600 looks to me like another potentially good example.

For my money (and I've used and dealt with professional machines for quite some time), forget IBM compatibility and take each machine on its merit. If it runs CP/M-86 or even CP/M-80, you won't find any shortage of software. When Digital Research finally gets Concurrent CP/M-86 right (how many perfect working installations have you seen?), then with any luck this will kill off MS-DOS altogether (Concurrent runs MS-DOS programs. MS-DOS does not run Concurrent CP/M-86 programs).

Until then there are thousands of packages available for CP/M-80 and CP/M-86.

P Scargill

Benchmarks

As a regular reader of *APC* I have been waiting to see a Benchtest of the business world's true pace-setter — the Wang PC. After your review of the IBM AT I ran the Benchmarks on the Wang PC, and with crude timing methods obtained the following results:

BM1 . . . 0.8	BM5 . . . 5.0
BM2 . . . 1.9	BM6 . . . 9.0
BM3 . . . 4.0	BM7 . . . 13.0
BM4 . . . 4.0	BM8 . . . 15.0

Average 6.59

This performance would put the Wang into second place in your Benchtest roundup without the help of a maths co-processor or compiled Basic! As these two options are available, the Sage II may prove a pretender to the throne.

K Beales

Micro musts

Not all the features needed in the real world of personal computer systems' users are among those you see on the usual micro charts. There are still some things I miss. For example:

A minimal start-up time — when I started with my WP program, it was taking three minutes to load from cassette. With a succession of upgrades I finally cut that down to seven seconds;

Minimal desk imprint — this includes the possibility of moving the keyboard off the desk space altogether when not in use, and there's no spaghetti junction of wires;

Maximum user-friendliness — this begins with the keyboard and the screen. It includes a placing of the cursor keys to suit touch-typing, unless cursor movement can be catered for better with voiced commands. Some fancy systems, with cursor keys placed on a far corner of the keyboard, are hopeless in this respect;

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Jan-Mar
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Internal power back-up — this goes with portability, or at least with not being wholly dependent on mains power in one place. Segmentation, if only combined with battery power, might be the best solution;

Printer quality with versatility — what is needed is a better way than I have yet seen of combining letter-quality mode with draft speed and print variety. Perhaps we need a combination of 24-wire head printers with personal typesetter programs;

Program access to printer capacity — programs (I am thinking especially of word processing programs) should be able to access anything any printer can do: for example, if print commands in ASCII code are provided for. Ideally it should be effective both for screen display and for printout, so that you can see what you'll get.

Parig Digan

Not quite right

I have been reading your journal for quite some time and generally find it quite factual. One exception, however, is David Ahl's comments in the December 1984 issue. Under the heading, 'Eat your words' he states: 'In 1950, a study by Univac indicated that five computers would meet the total worldwide demand for the foreseeable future.'

In 1949, one year before his 'study', there were actually six Univac Is already on order, three for the government and three for industry, with additional contracts being actively pursued. When Remington-Rand purchased the Eckert-Mauchly Computer Corporation in February 1950, the production plan called for an initial run of 10 or 20 systems. At no time did anyone ever think that the total demand was as ridiculously low as five. The only problem was one of deciding how much of a production commitment to make in advance of firm orders.

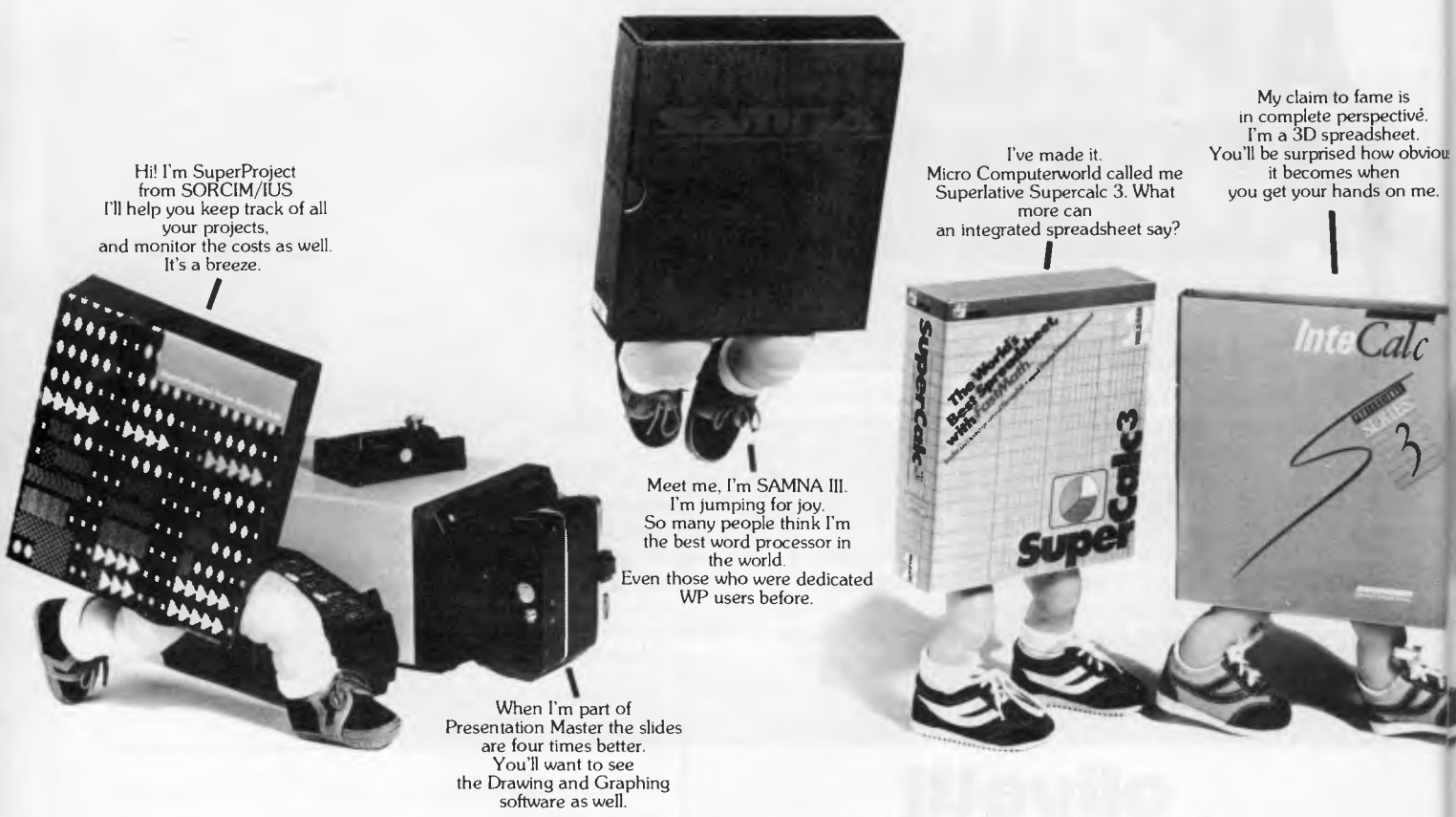
It is true that some studies were later carried out, but none of them ever indicated a number as low as that quoted by Mr Ahl.

James Weiner

Only the memory lingers on

After reading your two articles published in Newsprint (February '85), I have met with some conflicting views. The articles that I am referring to are: 'When at first you don't succeed' and 'Coleco calls it quits on Computerland'. These articles clearly, and without a doubt, state that Coleco has definitely stopped manufacturing the Adam microcomputer and its associated products. It further states that it has sold its stocks of the machine to a retail chain and that it plans a phone for Apple software but it has no intention of marketing it itself. The word 'optimistic' and 'sucker' are used which, in my opinion, lowers the quality, reliability and usefulness of the machine to a point lower than a cheap calculator, let alone a computer.

I am a buyer of the product and unlike some people who bought the machine for sophisticated game use, I bought the computer for serious school and general use. By this I mean word processing and database applications. I believe that the product is of an exceptionally high standard for the price (I paid $995) and the machine does not deserve



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the criticism you have given it.

Further on to the reason for this letter. I have spoken to the national distributors of the product (Computer Distributors) who have assured me that Coleco has no intention of discontinuing the product. I have written to them and am awaiting confirmation in writing. Furthermore, I have spoken to Honeywell who said that Coleco would have informed them if the product was to be stopped. I have also written to Coleco in New York for further notice on the status of the product.

If the verbal assurances are true, which I will soon know, then I am at a loss to see how you could have printed those articles. I have waited so long before writing this letter because I expected either a further confirmation about the article or a withdrawal of the article along with an apology. None of these eventuated.

Since this situation is so, I can only demand that you send me documented evidence upon which the article was based. If this evidence is not presented to me, then I only have the power to say that your magazine loses a tremendous amount of credibility with me personally.

In conclusion, I can only say that if *Australian Personal Computer* really wants to publish a genuine opinion of a reader then the publication of my opinion will perhaps open the eyes of some of your readers.
B Bakalis

Answering your points in order:
— In the first item you quoted Guy Kewney did not mention a 'phone for Apple software', he spoke of a 'phone which runs Apple II software'.
— The word 'optimistic' was used by David Guest (in the second piece mentioned) in reference to the retail chain which purchased remaining Coleco Adam computer stock. APC stands by this description and asks: would you like to have to flog computers which are no longer produced; have little software and virtually no hope of any more being produced; and for which there is, at best, very little support in terms of maintenance and space parts?
— The word 'sucker' was not used in reference to the Adam but to the Apple II software compatible phone.
— Production of the Coleco Adam *has* ceased despite what you were allegedly told by Computer Distributors and Honeywell.
— I don't understand why you expected *APC* to provide 'further confirmation' if the articles are correct. *APC* could devote an awful lot of space to confirming previous month's reports if it were to adhere to your expectations.
— If you do not receive the written confirmation from either of the three parties you have communciated with, please advise me and I shall call Computer Distributors on your behalf.
— Ed.

Disk alternatives

Compared to their ever-increasing performance, computer prices are falling continuously. As for disk drives, price cuts are not and will never be as spectacular.

A low-priced home micro costs around $200. The disk drive which goes with it is more like $400. So for the non-professional user, a disk drive is rather expensive

To obtain more information about these products, circle those that interest you and send to Freepost 2, P.O. Box 13, Clayfield, Q. 4011. No stamp required.

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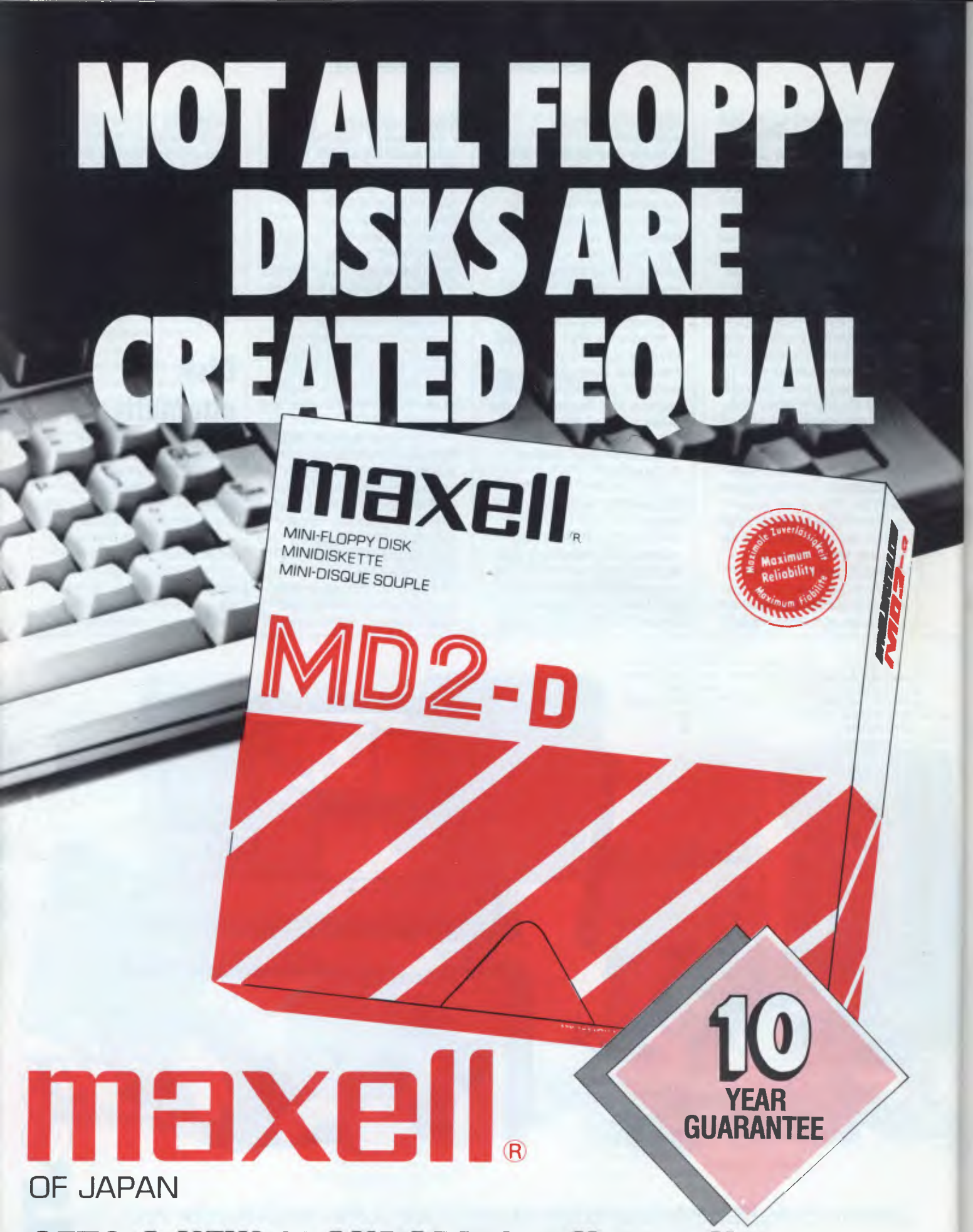

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LETTERS

for what it basically does — storing and retrieving data — in comparison with the multitude of basic functions of the cheaper micro (keyboard, video control, music, programming).

A disk drive also has secondary functions: the organisation of the data (copy, delete, merge, directory); these functions make the drive so expensive. An answer would be to have a computer capable of carrying out these secondary functions.

I envisage a micro with 512k RAM, 64k ROM and a fast tape or streamer as a mass storage device. Loading and saving would only be possible in sequential blocks of a fixed length — 192k RAM. This would make the tape operations very simple: a computer controller start at the beginning and a stop at the end of the block. Without making the streamer too expensive, it still must be possible to load or save a block in less than 15 seconds.

Organising the data before saving would also be very easy: it is only a matter of changing the data locations in the memory. Random accessing would no longer be a time consuming operation. With 512k RAM as memory, it is possible to have two big blocks in the computer for merging and copying of files. Moreover, the DOS could be replaced by a simple and short menu-driven program.

It should be possible to build and sell a micro of this type with a fast tape for less than $400. Besides, the potential computer power is much higher than the 64k RAM machines currently available.

C Eddy

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There are many C compilers now available for the Z80 and 8086 (or 808) processors; the quality ranges from terrible to quite good, and not all are available for both processors. Now there is a wholly Australian-developed compiler which outperforms all the others in all areas. HI-TECH C produces smaller, faster code than any other compiler for these processors, has a better user interface and provides features which are optional extras with the others. Furthermore, HI-TECH C delivers what we promise; although there is no such thing as bug-free software, we do not release unreliable products.

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Z80 BENCHMARK (2Mhz Z80)

Program: Primes (Eratosthene's sieve)

Compiler	Execution Time	Compilation Time	Program Size
HI-TECH C	40	100	4153
Whitesmiths	60	420	15745
C/80	63	140	3584
Aztec	78	144	9168

8086 BENCHMARK (IBM PC under MS-DOS)

Program: Eight Queens

Compiler	Execution Time	Compilation Time	Program Size
HI-TECH C	14	105	4500
Lattice C	17	111	14000

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YANKEE DOODLES

It wasn't just the big names that made an impression at this year's CES: our US man-on-the-spot dug a little deeper . . .

Commodore and Atari attracted all the attention at the Las Vegas Consumer and Electronics Show earlier this year, with the result that the software and peripheral companies were unduly neglected. So to redress the balance, here's a round-up of the best of the rest.

Activision, once king of the Atari 2600 VCS game world but now a much slimmed-down company, was not showing a single 2600 game. An open letter from president Jim Levy said: 'We believe that 1985 is the beginning of a new era for home computers and home computer software . . . ' On the bright side, Activision was showing some of the most playable games on the show floor.

The most effective product demonstrators at CES? No contest. The kids, aged eight to 14, who were demonstrating the line of games from *Epyx*. President Mike Katz, one of the best promoters in the business, happily stood back and let these youngsters steal the show. 10 new entries from Epyx included two excellent games from Lucasfilms: a sci-fi game, Moreta, and Dragonlady of Pern; and high-tech versions of Barbie, Hot Wheels, and GI Joe. These latter three games provide non-structured creative play for children four to 10 years old.

Wico introduced the SmartBoard, an intelligent keyboard/trackball peripheral for the IBM PC and Apple II. Each of 10 function keys can be programmed to contain as much as 126 data characters, while the trackball can be used for cursor movement or mouse emulation.

Flyers favourites: the new *SubLogic* Flight Simulator II and the *MicroProse* F-15 Strike Eagle games. The F-15 is fabulous, with its radar and infra-red guided missiles, bombs, cannons, ECM, flares and full aerobatic capabilities. Cut in the afterburners and watch this one move out! I hear that some fanatics have hooked two computers together and staged interactive dogfights. I didn't see any, but I did see a similar set-up with the Nexa MSX flight simulator program.

Sherwin Steffin, formerly of EduWare, showed the first products from his new company, *Brainworks*. Most interesting in this 'discovery learning' series is Chipwits, a game which features robots that can be programmed by illustrated chips (icons). Once programmed, the robots are placed in one of eight environments where they must survive a number of situations and tests.

A unique new entry from *EduWare* is Wilderness, a survival adventure which uses state-of-the-art graphics coupled with accurate, detailed models of the environment and human physiology to recreate a true-to-life wilderness survival experience. Dr Wesley Huntress, a scientist at JPL, and Charles Lohlhase of the Voyager Project, developed the program. Dr Huntress demonstrated it to me and, although my scouting days are a dim memory, this program rekindled a strong desire to return to the wilderness.

One of the nicest Apple shape table packages is Pixit by *Baudville*. The company has produced Blazing Paddles (a draw, paint and print program) and Take 1, an animation program that allows you to define shapes and movements, 'shoot' scenes, add text, and combine scenes to make a complete movie. And in case you need more help, Baudville has three animation libraries of backgrounds, actors, and scenes — Actors & Actions, Heroes & Villians, and Business. Easy to use and barrels of fun!

Niftiest product that will never reach the market: *Toki's* biometal robot. This miniature robot is controlled by a titanium-nickel alloy which 'remembers' a shape or position. Heating the joints by a pulse current extends them, but when they cool, they return to their original shape and position. Toki was also showing an innovative light-driven interface that could control the robot or other motors and household appliances. I'm rooting for you Toki, but . . .

Springboard Software (formerly Counterpoint Software) introduced several fascinating products, foremost of which is The Newsroom; this program allows users to create and print an actual newspaper. Users can call upon a library of more than 600 pieces of 'clip art', and the program, and its 90-page manual, help students in editing, layout, copywriting and production.

Woeful is the troll that doesn't act quickly in Trolls and Tribulations, a new strategy/action game from *Creative Software*. The player must lead trolls through treacherous underground caverns to recover treasures.

In Break Street, players guide game characters through breakdancing movements such as the tut, scorpion, windmill and moonwalk. The DeRoxy Crew, a Seattle breakdancing group, was consulted on the game's development.

Going for the big names is the strategy of *Simon & Schuster's* Electronic Publishing Group. Initial entries include com-puterised IBM PC versions of JK Lasser's Your Income Tax and Your Money Manager, Webster's New World Spelling Checker, The Great International Paper Airplane Construction Kit (for the Macintosh), and a non-celebrity clip art program for the Mac, The Mac Art Department.

Electronic Arts displayed several new items including a Mac version of its Financial Cookbook, a Racing Destruction Set which allows players to design their own tracks and race cars, the Adventure Construction Set, and Mail Order Monster (a robot kit in which creatures can be designed and pitted against each other in three levels of combat).

Random bits

Business Communications of Stamford, CT, forecasts 20 per cent annual growth over the next five years in business micros, 22 per cent in peripherals, 38 per cent in maintenance, 41 per cent in communications, and 46 per cent in software . . . AT&T claims that its Unix System V is gaining support, particularly now that Microsoft has agreed to make its Unix-type system, Xenix, compatible with System V. Nevertheless, some software vendors are shying away from Unix because of AT&T's recently announced more restrictive licensing policy . . . Televideo Systems has just signed an agreement with three Chinese companies to manufacture and market PC-compatible machines there . . . Looking for a winner in 32-bit Unix systems? Charles River Data Systems is shipping products, and has just signed OEM deals with both Datapoint and Sord of Japan. Financial backers include EG&G, Analog Devices, Meditech, and now Datapoint . . . Apple's fourth quarter earnings leapt nearly eightfold to a record $46.1 million on strong Christmas sales of the Apple II line . . . IBM earnings also climbed 17 per cent in the fourth quarter while Tandy's fell 24 per cent . . . Analysts see the home computer market returning to more orderly growth in 1985. Infocorp projects 1985 sales of 5.7 million units, up from 4.4 million in 1984 and 3.4 million in 1983 . . . On the horizon: a graphics entry device called Space Tablet which lets you draw in 3D space . . . The top priority project at Pioneer is a writable videodisk for the home market

END

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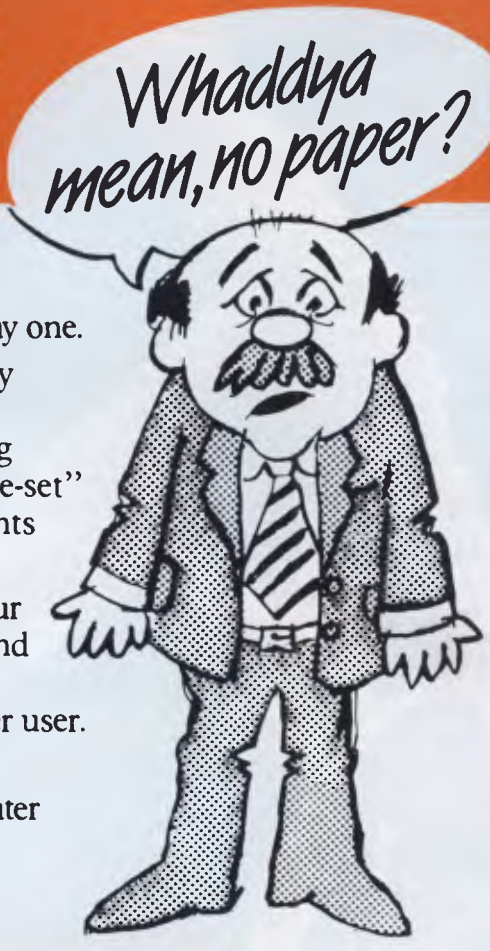

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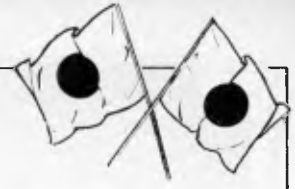


From Family Computers to fifth generation research, Shinichiro Kakizawa rounds up the latest news from Japan.

The Family Way

Japan has a hidden million-seller machine — 2,300,000 units have been sold in a year and a half. The manufacturer is at present shipping 10,000 daily and all are immediately claimed by waiting enthusiastic customers.

The machine is The Family Computer manufactured by Nintendo. The name may be familiar. Together with other popular brands like Casio, the firm is one of the major suppliers of popular pocket-sized game-watches. The model name Family Computer is slightly misleading, however. At first sight the machine looks like any ordinary games computer. The standard model costs $70 and has no keyboard, but it does have a slot for the software ROM cartridge, a few buttons (start, reset) and two joystick controllers. If you want to use the FamiCom (its nickname) as a micro, you will have to buy a separate keyboard that contains Basic ROM.

As far as the functions are concerned, the standard FamiCom model is no different from machines like the Atari 2600.

So what is the secret of the 2.3 million sold in this era of sophisticated home computers? To find out, I went to buy the machine. I tried four shops in my neighbourhood — FamiCom was out of stock in all four. They could not even tell me when they would receive their allocation of the next shipment. But one of the shops, a toy shop, had a demo machine.

The machine has incredible speed — the graphics are faster than anything else I've seen. The FamiCom's speed is so superb that the actions of the game's characters look very realistic and smooth. The colours are also very good and the combination of these two features appears to have created a new games computer which has been keenly accepted by even arcade players.

Most industry observers thought that the games-only market was almost dead, as Atari saturated the market, and has subsequently been replaced by low-cost home computers such as the Commodore 64 and MSX. However, the success of the FamiCom has proved that this is not the case. Users are certainly tired of low-quality video games but not of these high-quality products.

Nintendo currently offers 30 games programs, all developed in-house; the cartridges cost $25 each. The programs are all standard types such as golf, tennis, car chase and Pacman, and Nintendo has sold 14,000,000 cartridges in total — half a million copies of each game. The only difference between Nintendo's and other games is the quality.

Nintendo was a latecomer to the games/home computer market so it had time to study the market; it has designed fast customised chips and set the right price level. The result is a phenomenal two-million seller. Nintendo believes that it can sell at least another three million machines here, and the only limiting factor in achieving this goal seems to be the speed of chip production which is subcontracted to Ricoh.

Nintendo plans to start exporting the FamiCom to the US in July, and entry to other markets will certainly follow in time.

MSX moves on

MXS version II will be ready in May. ASCII, which originally developed the MSX concept and organised the MSX manufacturers' group, is now working on an improved version.

A new range of improved MSX machines will be announced at the Tokyo Business Show on 22 May, and most of the suppliers currently offering MSX micros will announce new models.

The new MSX will still have the same 8-bit CPU but will include a more powerful graphics capability (the display resolution of the existing MSX is 256 x 192); this will be upgraded to 512 x 200. A floppy disk system will also be provided as standard.

All existing MSX software will be compatible with the upgraded machines. The new micros will cost $90–$120 more than the existing models.

The fifth generation

Mitsubishi Electric is planning to mass-produce a personal AI workstation developed by ICOT, the Japanese Government agency for developing Fifth Generation Computer Systems.

The AI system is called PSI — Personal Sequential Inference Machine — and was the highlight of the Fifth Generation Computers International Conference '84 held in Tokyo last November. The PSI is the world's first dedicated Prolog machine. The fact that the operating system (SIMPOS) is written in a specially developed non-procedural language called ESP was considered unique by many researchers. PSI features a 32-bit ALU and 40-bit internal bus architecture.

The system description language is called KL0 — Kernel Language Zero — and is basically an extension of Prolog. ESP is written in KL0; execution speed of PSI is 45k LISP (Logical Instruction Per Second). The commercial version of the ICOT-developed machine will be available during the next year, and will cost from $50,000 to $100,000.

As many researchers are interested in KL0 and ESP, the Ministry of International Trade and Industry (MITI) — the sole proprietor of research results from the fifth generation project — is considering making the source codes publicly accessible on a limited scale, prior to the commercial availability of the Mitsubishi machine.

In addition, NEC is working on a back-end processor which can process KL0 six to eight times faster than PSI. Also, in its second stage research programme, COT will develop a VLSI version of SIM — Sequential Inference Machine — in order to reduce the machine's cost and size.

Analysing disks

A system which analyses, displays and prints physical formats of any floppy disk type has been developed by Nippon Office Communications, which is based in Tokyo.

This powerful aid for software developers can also modify any necessary part of the format and data contents in the disks. Its main functions include analysis of track formats, display of gap, sync, track dump listing, sector dump listing, disk zap, ID dump, modification of ID, data dump listing, data modification and parameter dump. If required, the machine can produce exact copies. Any type of 3-8in disk drive may be connected to the system.

The system costs $3,300.

Epson PX-4

Epson's PX-4 offers portable communications and text processing in a small, battery-powered unit. Will it serve as a boon to users in the field? Peter Bright takes a look.

Over the past year the market for small battery-powered portable machines has taken off, but the leaders in terms of volume are probably still the first Kyocera machines which are marketed under the banners of Tandy, NEC and Olivetti. These machines offer basic communications and text processing facilities at a reasonable price.

The PX-4 is aimed squarely at people who need portable communications and text processing facilities with more advanced features than those available on the Kyocera-type machines, but who don't want to pay too much extra.

Hardware

The machine is certainly a very compact piece of work: everything is enclosed in a case measuring just 34mm high by

297mm wide by 216mm deep.

At first sight it looks very like the Epson PX-8 (Benchtested in the July 1984 issue of *APC*), which is hardly surprising; the most obvious difference between the PX-4 and its 'big brother' is of course the width of the screen.

The whole unit is encased in extremely high-quality, cream-coloured plastic casing to give a very solid, well-made look. Everywhere you look on the PX-4 there's a slot, plug or hatch, so I'll start with the bottom and then work around the sides.

The bottom of the machine houses two covers, one switch and a catch arrangement. The smaller of the two covers hides the battery compartment. The unit can either work off four AA-sized dry cell batteries or from their rechargeable equivalents; the review machine was supplied with the rechargeable variety.

To save power, the system switches itself off after a preset time, which can be set by the user using the 'Config' program. When the batteries get low a warning appears on the screen, and the machine refuses to be switched on again. When you do find some power, it at least has the good grace to come back at the point where you left off.

The larger of the two covers hides two ROM sockets; these can be used to plug in ROM-based software so that there's no need to load the software from disk. Most ROMs from the Epson PX-8 will apparently fit, although the WordStar ROM I tried didn't work. The review system was supplied with a Basic ROM and the other slot was free.

Next to the battery compartment is a switch marked 'Backup On/Off'; this allows you to switch on or off the battery backup for the RAM. Normally it would be left in the 'On' position.

The final object of interest on the underside of the unit is a complicated catch arrangement; this allows you to remove a module which takes up most of the area to the right of the screen. On the review system the module was empty, but a whole range of add-ons can be plugged in here to expand the unit. These include a microcassette mass storage device, ROM packs, RAM packs and a micro printer.

The left-hand side of the machine houses a cover which, when removed, reveals a 50-way system expansion bus connector for expanding the system.

At the back of the machine, we find even more buttons, holes and slots.

On either side of the back panel are two feet which can be flipped down to alter the unit's typing angle. In the centre of the panel are five connectors: first is a micro DIN plug which allows you to connect an external cassette recorder for mass storage. The next two are RS232 serial ports; these are again configured as micro DIN sockets rather than the more usual (but space-consuming) 25-way D plugs. Both the serial ports can be run at up to 38,400 bps, which is unusually fast for an RS232-type line as most micros are hard put to generate 19,200bps.

The Epson P-40 micro printer will fit inside a briefcase

Next along the line is a 20-way connector which functions as a centronics parallel printer port; this allows the unit to drive a wide range of popular printers. Finally, on the back, is the power input for running the unit and recharging the batteries if necessary.

Along the right-hand side of the unit are: an output to an external speaker; a bar code reader input; power on/off switch; viewing angle thumbwheel for the LCD; and the reset button. The reset button can only be reached with a pen or other long, thin implement, so there's no danger of accidentally switching the unit off.

The Epson PX-10 portable disk drive is an impressive piece of work

I didn't make any serious attempt to get inside the unit. Although it looks possible, CMOS electronics are not fond of static and there would have been little point in opening it up.

The PX-4's main processor is a CMOS Z80 running at a commendable 3.68MHz. This is supported by a CMOS 7508 4-bit slave processor which looks after the keyboard and handles power switching.

Nearly 4MHz is a respectable achievement for a CMOS Z80, and largely accounts for the comparatively speedy operation of the unit. It was certainly faster than many other small CMOS machines I have tried.

As standard the system is supplied with 64k of battery-packed CMOS RAM. If required, part of this can be set aside as a RAM disk. The 7508 slave processor also has its own 4k of dedicated RAM, while the standard ROM, which holds the operating system, has 32k. Up to two other 8-32k ROM capsules containing applications programs can be added onboard to bring the total to 96k.

The system can handle a wide range of optional mass storage devices — the most popular will probably be the microcassette unit which is handled by CP/M as a sequential disk drive. Other options include an external tape recorder and RAM disks.

The review machine was supplied with the Epson PF-10 portable disk drive. This is a compact battery-powered 3½in disk drive unit which connects to the

main unit down one of the serial lines (which is why they were designed to go so fast).

The PF-10 really is a very impressive piece of work. It's fairly light, very small and, above all, it works off its own internal rechargeable batteries so there's no need to go looking for a power supply.

The review system was supplied with an Epson P-40 micro printer; this is a very small thermal unit which also fits inside the briefcase. Again this connects to the main unit via one of the serial lines.

Like most portable machines, the keyboard on the PX-4 is built into the rest of the machine. Where it differs from other portables is that the unit is available with two different keyboards.

Although the keyboard looks as if it's part of the whole unit, it's actually held on by three screws and three lugs. If you remove the three screws, the whole keyboard unit lifts off. Electrical connection between the keyboard and the rest of the unit is achieved by 22 spring legs making contact directly with the main PCB, which proved to be a very neat and practical arrangement.

The main keyboard supplied with the machine is a fairly standard typewriter-style unit; the second is a heavy-duty membrane multi-purpose unit.

The membrane unit is designed more for data capture and in-the-field work rather than long-term typing. It has a separate numeric keypad area and is supplied with keyboard overlays so that it can be customised for specific applications.

The review machine was supplied with the typewriter-style keyboard; this features 72 keys all grouped fairly closely together to make them fit into the confined space available. Considering the lack of space, this keyboard is well designed and laid out. Although the keys aren't pitched, they are still easy to get at.

Rather than separating the different functions of the keyboard by spacing them out (there isn't any space), they are assigned different colours. The main qwerty typing area keys are dark brown, the RETURN key is bright red, the cursor keys are orange and all the other typing keys are light grey. This all looks very striking, although I feel the colour scheme is a little overdone.

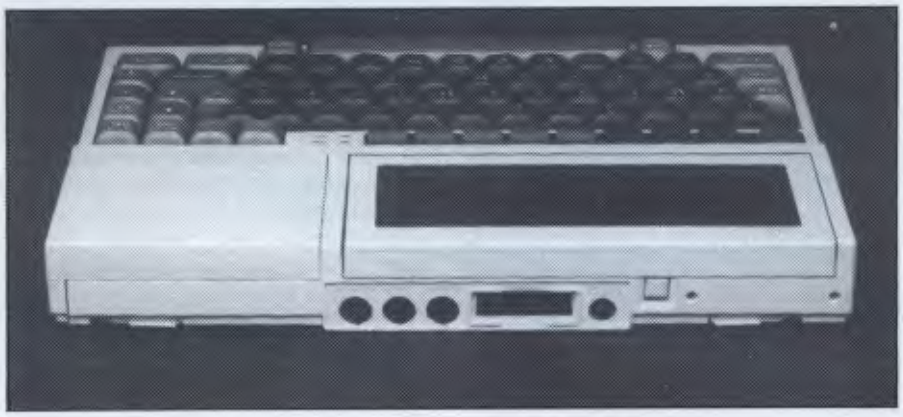
In addition to the typing keys, there are nine special function keys. Five of these are set aside as programmable function keys which can be used from within an applications program, and the rest are labelled STOP, ESC(ape), PAUSE and HELP/SYSTEM. These keys are used to control the system and are discussed further in the software section.

Although there's no separate numeric keypad, the keyboard does consider calculator buffs by providing a 'Numeric' mode; this converts the M, J, K, L, U, I and P keys into a numeric section for entering numbers. Although this can be useful, it can also be very annoying if you engage it by mistake and type '250' instead of 'KIM'.

Overall, I liked the keyboard. The typing keys have a nice feel, the editing keys are thoughtfully arranged, and the whole thing worked well as a unit. A nice touch is that LEDs have been provided to indicate whether the CAPS LOCK, NUMERIC or INSERT key has been pressed — which overcomes any problems trying to work out what mode you're in.

The display on the PX-4 is a 40-character by 8-line liquid crystal display (LCD). This is located in the top left-hand corner of the unit and can either be used flat or tilted up to allow better reflection of light. A thumbwheel on the far right-hand side of the unit can be used to adjust the contrast.

As with all other machines using LCD displays, the positioning of the unit is fairly critical in order to achieve good



A 20-way connector on the back functions as a Centronics port

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"Samna word III is the best of several word-processing programs I've tested, including WordStar, Easywriter II, Volkswriter, Volkswriter Deluxe, and MultiMate. I use Samna at home on my PC and a Micom wordprocessor at work. I like the speed of the Micom, and this makes me fidgety when Samna takes too long to complete an operation, but Samna Word III's many special features more than compensate for this problem. I'd rather work with Samna Word III than with a dedicated word processor."

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results. Having said that, this machine has one of the most easily readable displays I have come across. It may not be as big as some, but at least it's usable!

In fact the limitation on the size of the screen is not as great as it might at first seem, because it's possible to use the screen as a window onto a much larger 'virtual screen'. This virtual screen can be set to either 80 columns by 25 lines, or to 40 columns by 50 lines. You can easily pan around the virtual screen by using either the SHIFT or CONTROL key along with the arrow keys. SHIFT/arrow will move you one line or character, and CONTROL/arrow will move you by a screenful.

The combination of this virtual screen capability and the CP/M operating system is very fortunate. Most CP/M programs expect to be able to use an 80 column by 25 line display — they could get quite upset if they found they only had 40 columns by 8 lines!

The screen goes a long way towards making up for its small size by its sheer usability. Lately I've had my fair share of large, unreadable LCDs: it makes a change to find one (albeit a small one) that I can read.

My only criticism of the screen is the characters. Although they are reasonably large, they don't have true descenders: that is, the 'g's, 'j's, and so on don't hang below the line. Although this isn't a major problem, it certainly looks odd.

System software

The PX-4 is supplied complete with CP/M in ROM, which gives it theoretical access to a wide range of 8-bit disk software. The ROM version of CP/M looks and behaves in much the same way as good old disk-based CP/M; if you've been brought up on the IBM PC, you don't know what you're missing.

The major difference is that most other CP/M systems have a 64k transient program area (TPA); this is the area of RAM which is available for applications programs. The maximum available on the PX-4 is 55.5k and if you're using a RAM disk it's even less, but this is not as big a problem as it seems at first. Most applications on this machine will probably be stored in ROM; indeed it's possible that the Scan applications software described later is the only program you'll ever use.

When you first switch on the machine, you're taken into a menu system. This allows you to choose between the applications currently in the system by highlighting them with the cursor, and then to execute the application by hitting the RETURN key. If you don't like menus, you can get out by hitting the ESCape key

What makes Macintosh tick. And talk.

The brain of the Apple Macintosh uses a blindingly fast 32-bit MC680000 microprocessor. Far more powerful than the 16-bit 8088 found in current generation computers.

The 16-bit 8088 microprocessor.

Macintosh's 32-bit MC68000 microprocessor.

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Which makes the 32-bit power not only more useful but easier to learn.

Another miracle of miniaturisation is Macintosh's built-in 90mm (3½") microfloppy disk drive. Its 90mm disks store more than conventional 135mm (5¼") floppies – 400K. So while they are big enough to hold a desk-full of work, they are small enough to fit in a shirt pocket.

Standard 135mm (5¼") floppy disk.

Macintosh's 400K 90mm (3½") disk.

And, thanks to its size, if you can't bring the problem to a Macintosh, you can always bring a Macintosh to the problem. (Macintosh actually weighs less than 9 kilos.

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And speaking of talking, Macintosh has a built-in polyphonic sound generator capable of producing high-quality speech or music.

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On the back of the machine, you'll find built-in high speed RS232 and RS422 AppleTalk/serial communication ports. Which means you can connect printers, modems and other peripherals without adding $250 cards.

It also means that Macintosh is ready to hook into a local area network. (With the AppleTalk Personal Network, you'll be able to connect up to 32 computers and peripherals.)

Should you wish to double Macintosh's storage with an external disk drive, you can do so without paying extra for a disk-controller card – that connector is built-in, too.

And, of course, there's a built-in connector for Macintosh's mouse, a feature that can cost up to $500 on computers that can't even run mouse-controlled software.

Of course, the real genius of Macintosh isn't its serial ports or its polyphonic sound generator.

The real genius is that you don't have to be a genius to use Macintosh.

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277mm (10 9/10")
247mm (9 7/10")
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Ultra compact, switching-type power supply and high resolution video circuitry.
Battery for Macintosh's built-in clock/calendar.
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Thanks to ample venting, Macintosh needs no internal fan.
Brightness control.
128K or 512 bytes RAM.
Built-in 90mm (3 1/2") disk drive.
Connector for keyboard and optional numeric keypad.
32-bit Motorola MC68000 microprocessor.
64K bytes ROM.
Clock/ calendar chip.
Macintosh's digital board – the processing power of an entire 32-bit digital graphics computer in 80 square inches (516 sq. cm)
Apple

which takes you back to the CP/M A> prompt.

If you hold down the CONTROL key while hitting the 'Help' function key, you're taken to another menu which allows you to play with the menu system, set an alarm, or set an application so that it auto-runs when you switch on the machine.

If you decide that you don't like the application selection menu, you can switch it off permamently from here: the alarm takes advantage of the PX-4's built-in clock calendar chip. You can set the system to call you at a certain time and give you a message, and you can even set the system to switch itself on.

More ambitious users can use the Config program to set up the system to their own specifications. Using config you can set auto-power off, CP/M function keys, country, cursor type, date and time, disk drives, RAM disk, communications, screen mode and the printer port.

Auto-power off is the amount of time the system will allow itself to do nothing before it switches itself off to preserve power. Function keys allows you to assign CP/M commands to the programmable function keys; disk drives allows you to assign logical device names to the physical devices; and RAM disk allows you to set the size of the internal RAM disk.

The review system was supplied with the Basic ROM for Benchmarking purposes. This is much the same as the Epson PX-8 ROM Basic, which in turn is an enhanced version of Microsoft Basic-80.

Documentation

The PX-4 was supplied with three manuals: one for the system, one for the Basic and one for the Scan software. The first two were thick, book-bound A5 style, while the latter was a preliminary version only.

All three were adequate.

Benchmarks

BM1	2.3
BM2	6.0
BM3	14.3
BM4	14.1
BM5	16.7
BM6	30.7
BM7	47.8
BM8	63.5

All timings in seconds. For a full listing of the Benchmark programs, see 'Direct Access'.

Prices

The PX-4 with CP/M and utilities costs $1074. Strangely the manuals are charged for separately at $21.60 each. The microcassette costs $233 and RAM cartridges are $240 each. All prices include sales tax.

No price was available for the Scan package at the time of going to press.

Conclusion

On the hardware side, I found a great deal to like about the PX-4. It's very well made and offers that reassuring feel you find on the likes of Hewlett Packard kit rather than on budget portables.

Although it doesn't break any new technological ground, it does have the overriding advantage of usability. The screen may be small, but at least you can read it.

On the software side, the Scan communications/text processing software is more than adequate for providing rough copy in the field.

If you need processing/comms ability in a cheap package, and you're prepared to talk to Talbot direct rather than explore your local shops, then add this machine to your list.

Further details from Epson Australia on (02) 452 5222.

In perspective

In terms of price, the machine is competing with the Kyocera machines — Tandy 100, NEC and Olivetti M10 — and it has the edge over these machines. It's better engineered, runs CP/M and, with the software, offers more features than the Kyocera systems.

Technical specifications

Processor:	CMOS Z80 main processor running at 3.68MHz, CMOS 7508 for keyboard and power sensing
ROM:	32k operating system, plus up to two other 32k applications ROMs
RAM:	64k
Mass storage:	Optional RAM disk, floppy disk, microcassette or external cassette recorder
Keyboard:	Either 72-key typewriter style, or specialised membrane customised keyboard
Size:	34mm x 297mm x 216mm
I/O:	Bar code reader, cassette, two x RS232, parallel printer, system bus
DOS:	ROM-based CP/M
Bundled software:	Scan text processing/comms software
Power:	Either external supply four AA-type dry cells, or rechargeable equivalents

Applications software

by Peter Vernon

SCAW is a scheduling, communications and word processing system, supplied on a ROM capsule. The word processing and communications programs work together to allow the user to enter, edit and print text files and communicate with other computers. The scheduling component of the system maintains monthly calendars and daily appointment lists and even allows the PX-4 to be used as a high-tech alarm clock.

A fourth program allows the system to be configured to use various printers and printing formats, serial data transmission rates and communications protocols.

SCAW is entered from CP/M by either typing the name or selecting it as an option from the "system menu", allowing the user to choose the required function or return to the operating system.

Word processor

The word processor is the largest program in the SCAW system, and provides a wealth of editing, formatting and print control commands. Only seven lines of 40 characters each can be displayed on the LCD screen of the PX-4 (six lines if the function key definitions are displayed) and the word processor uses the screen as a window on the text file. The window can be moved horizontally to

allow the user to view lines up to 124 characters long and scrolled vertically to bring further lines of the file into view.

Text files can be as long as the available memory permits, because parts of the file are moved in and out of the RAM work area as required. Files are stored either in a 64k or 128k RAM disk module or an external disk drive. With back up copies 128k is equivalent to about 32 pages, which should be plenty for a portable word processor.

The SCAW word processor uses combinations of the control key and letter keys to move the cursor through the text. The letter keys used for cursor movement are chosen so that they form a diamond shape on the left side of the keyboard. Control-S, for example, moves the cursor one character to the right, Control-D moves the cursor one character to the left and Control-E moves the cursor up one line. Control-A and Control-F move the cursor one word to the left or right respectively and other commands scroll the screen up or down, seven lines at a time. In addition, the clearly marked PRINT SCREEN, BACKSPACE and TAB keys work as expected. The INS/DEL key toggles the word processor between insert mode (where letters are shifted to the left to make way for new text) and "over-type" mode.

The arrow keys can also be used to move the cursor, and in conjunction with the control key are used to move the screen 30 characters right or left to allow horizontal scrolling. Control + and Control – (plus sign and minus sign) also move the screen backwards and forwards through a file one "window" at a time.

SCAW also makes good use of the programmable function keys of the PX-4. The current definition of each function key is displayed on the bottom line of the screen by pressing the red HELP key.

The five function keys provide access to the formatting, block, search, file and print command sets of SCAW. The keys are defined in a layered fashion, so that, for example, pressing PF1 (edit functions) gives new meanings to the function keys to allow text to be reformatted within specified margins (indicated by a "ruler" line at the top of the screen) and turn word wrapping and justification on and off.

Function key PF2 (block functions) redefines the function keys to allow selection of individual block functions, such as move and copy. A marked block of text can be read back into the original or a different file, but only one block of text can be marked at a time.

Function key PF3 activates the search and replace selections, and PF4 provides printed special effects, re-defining the function keys as markers for underscore, boldface, subscript and superscript. These attributes are shown on the screen as control characters at the start and end of the text affected.

PF5 provides access to file commands, to save and read data to and from a file, and to delete a file. These commands operate on internal or peripheral RAM disks and add-on floppy disk drives.

While the edit mode of the SCAW word processor provides many facilities, the print mode is much simpler. Files must be saved to RAM disk before they can be printed, and the user has the opportunity to select the page number at which printing will begin and specify whether or not the printer will stop after each page.

Other printing parameters are set up in the fourth program of the SCAW series, Configurations. These parameters, including page length, margins and line length, are set in a "list format" for the SCAW system as a whole. Files can be sent to the RS-232C serial port, the second serial port or the parallel port, or printed on the tiny (40mm wide paper) built-in printer. Special printer control codes can also be defined in this menu.

Only one list format and set of printer parameters can be saved on disk at any one time as the default set-up, so you can't have different CONFIG files for different applications, which seems a pity.

Communications

The CONFIG selection is also used to set up communication modes. Versatility is the key word here, with a range of transmission rates from 150 to 38400 bps and the usual options for parity and other communications protocols. Also available, however, is a choice of answer/originate, and pulse or tone telephone dialling for an auto-dial modem and options to add or delete line feed and/or carriage return characters from text as it is transmitted or received. The default is CR but no line feed, which is hard to read on a standard terminal, but it can be easily changed.

The PX-4 can be used as a terminal, with text echoed to the printer, or to transfer files to and from another computer, either over the telephone or by direct RS-232C link. Files to be transmitted are selected by name, although the last word processor file to be active can be specified simply by typing an asterisk. As with all SCAW operations, the function keys are used to select various modes and activities.

With a suitable modem the SCAW system supports automatic telephone dialling and answering. Telephone numbers can be selected and dialled automatically.

The address book is chosen from the Communications menu, and again redefines the function keys to allow entry and editing of names, addresses and telephone numbers. For some reason, address book information cannot be treated as a word processing file, or text files transferred into the address book. This is a short-coming in an otherwise well integrated program series.

Appointments Book/ Alarm Clock

Apart from word processing and communications, SCAW makes the PX-4 a calendar, automated appointments book and alarm clock. The Scheduling component of SCAW is in some ways the most interesting. The internal clock-calendar is maintained by a separate battery, and allows the Scheduler to display a monthly calendar and separate diary pages for each half of the day, divided into hour long segments. Those days for which schedules have been entered are displayed on the calendar in reverse video and can be printed out. Notes can also be entered in a six line by 40 character format, and displayed or printed out for any range of dates.

Messages entered in the schedule segments (to a maximum of 32 characters for each hour) are activated at the specified time and date. Messages can be tagged for display with an audible alarm or switch the computer on (using the PX-4 WAKE function) and used as input to select another program.

Don't depend on the Scheduler to keep your personal history, however. You can't enter a note for a date earlier than the current system date, and SCAW automatically deletes information that is more than seven days old.

In conclusion

SCAW is everything one could want in a portable word processor and communications system, and the Scheduler features considerably increase the usefulness of the PX-4. Its convenient ROM cartridge format and use of RAM disk drives takes full advantage of the strengths of the computer, and the easy-to-use windowing facilities and function key operations overcome the limitations of the display and restricted keyboard.

We saw a preliminary edition of the manual for the system that obviously needs more work. It's clear and comprehensive, but somewhat disorganised at the moment, unlike SCAW itself.

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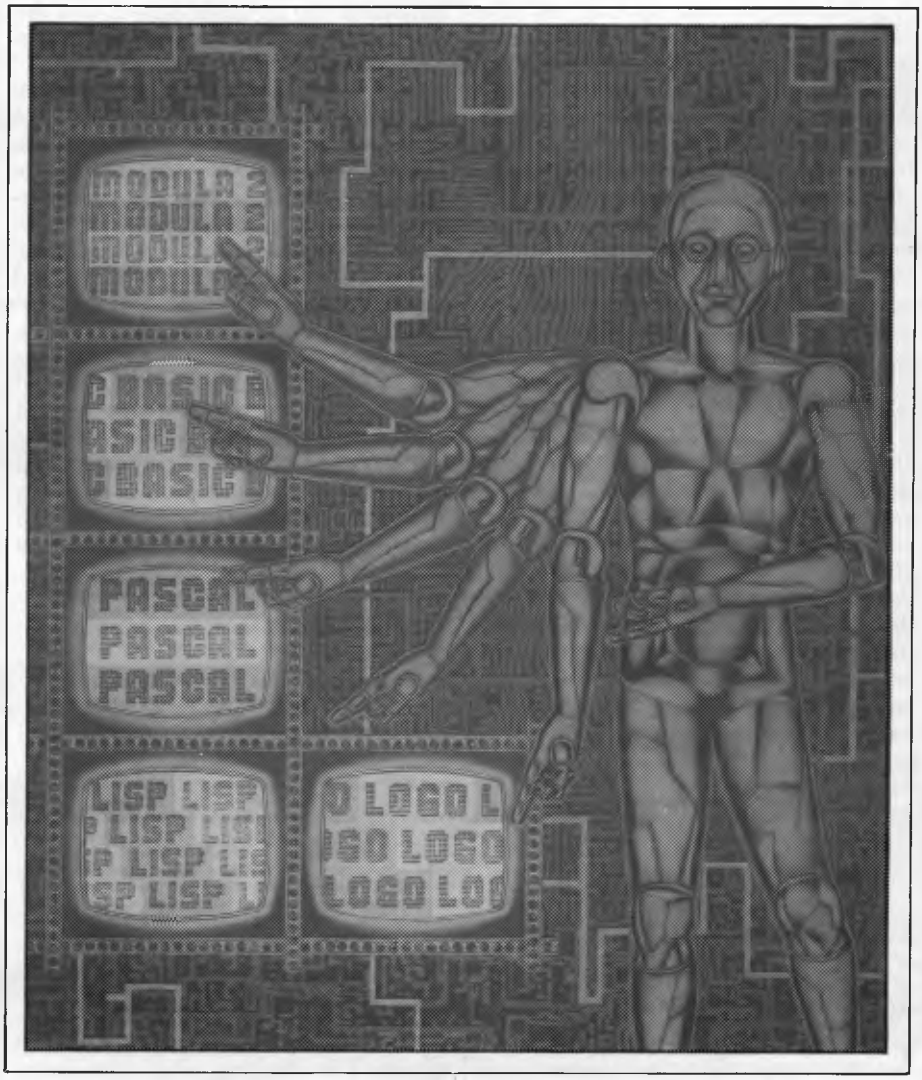
Mind your language!

Nick Walker begins a series of reviews of languages for popular micros with a look at Apple's own Basic for the Macintosh; and David Lightfoot follows this up with a test of Modula-2 — from the originator of Pascal, Professor Niklaus Wirth.



As a programmer who was seduced by the Apple Macintosh and its two applications programs, Mac-Write and Mac-Paint, I had doubts about programming languages for the Mac. Would it be possible to implement a language that uses the Mac's abilities as well as Mac-Paint does? And would the language provide access to those slick 'quick-draw' ROM routines, pull-down menus and other Mac niceties?

It was thus with a certain amount of trepidation that I received Apple's Mac-Basic. My copy was very much a pre-production version — the documentation was a photocopied rough draft and on numerous occasions I found myself with 'Macintosh has experienced a serious error' on the screen. But I did get a taste of the completed version.

Macintosh Basic arrives on one 3½in disk accompanied by a 200-page-plus manual. Upon booting up and reaching the menu screen you see a range of icons which feature Mac-Basic, the example program file and the empty file for storing programs. Position the cursor over the Basic icon, give the mouse a double click, and you're greeted by a single window awaiting your Basic program and a row of pull-down menus across the top labelled File, Edit, Search, Fonts and Program.

Program entry is via an editor that's closely modelled on Mac-Write, and a program created with Mac-Write will run under Basic. There are, however, a number of advantages in using the built-in editor. For example, all Basic lines that are terminated with a carriage return are checked for syntax, and if incorrect the Mac's traditional speech bubble-type error message occurs. These messages consist of a short English sentence, such as 'Not enough values for input list'. Further explanations of error messages can be found in the manual. The Basic keywords within a correct line are highlighted with a darker typeface which gives a rather elegant-looking program.

Mac-Basic also encourages you to indent lines, resulting in a program that is far removed from the jumble that can result from Basic programming.

Selecting File from the pull-down menus opens up the usual array of filing procedures — New, Save text, Save a copy, Print quick, and so on. The Edit

and Search menus include all the functions you would expect of a good editor such as Find, Replace, Copy and Paste, plus a few Macintosh-specific commands such as COPY PICTURE which allows you to copy the output from your Basic masterpiece to the clipboard. Using all these, editing is greatly simplified by the onscreen prompts that appear within a small custom window.

The Fonts menu is less useful. I don't see the point of including seven typefaces in five sizes for program entry, but it might relieve the tedium of typing in a long program.

I had no problems when I entered a short Basic program and ran it, but when I added a line to be inserted at the start of the program it wasn't so successful. Line 5 stubbornly remained at the end of the listing after line 40. It was then I realised that this Basic was different: a proper screen editor and a Basic that realises line numbers for what they are — nasty, dangerous labels. If more Basics were to follow this trend, people wouldn't be tempted to create labyrinth-like programs and would actually have to think before using a GOTO. In fact, line numbers are redundant as it makes far more sense to create an alphanumeric label that's meaningful in the context of the program.

Having acclimatised to Basic without line numbers, I ran a number of simple programs. It's all there — GOSUB, GOTO, REM, PRINT, and so on — very good, very standard and not very exciting. Time to refer to the manual (which promises to be a thorough if not over-friendly document) and look for something interesting. I wasn't disappointed.

In addition to the traditional Basic control structures, there are a number of different and better ones.

First of all there's a DO ... LOOP which is slightly unusual in that no condition can be applied to either the DO or the LOOP. The exit condition must be expressed as an IF statement within the body of the loop ending in the statement 'EXIT DO'.

As an alternative to GOSUB there's a CALL and SUB mechanism, the advantage being the ability to pass parameters. Both single and multi-line functions can be constructed, and the standard test of recursion worked without problems.

At a higher level it's possible to call another program via PERFORM. Once again it's possible to pass parameters, and sadly it's only at this level that local variables can exist. This program calling provides a rudimentary form of module organisation, but it should under no circumstances be confused with multi-tasking.

With regard to decision constructs, the IF ... THEN construct can, of course, be extended to a full IF ... THEN ... ELSE ... ENDIF, and there's a comprehensive CASE statement. Probably the most surprising and most useful (especially when dealing with, say, the mouse) is WHEN, which incorporates interrupt-handling into a program. So, it's easy to say

```
WHEN (The mouse moves)
(Deal with mouse)
ENDWHEN
```

and construct an entirely interrupt-driven mouse handler.

Two miscellaneous niceties of Mac-Basic are a number of SET option environmental controls, which bring Mac-Basic into line with the IEEE standard for floating point arithmetic, and the ability to put comments on the same line as source code.

'Two miscellaneous niceties of Mac-Basic are a number of SET option environmental controls, which bring Mac-Basic into line with the IEEE standard for floating point arithmetic, and the ability to put comments on the same line as source code.'

Mac-Basic scores over other dialects of Basic in its data typing (Fig 1). No fewer than 10 different fundamental data types are incorporated, each distinguished by a terminating character on the variable name as in BBC Basic.

There is also a vast array of built-in functions — 34 numeric functions and 12 string functions, excluding Macintosh-specific functions. Four logarithms, three exponents and business functions such as ANNUITY and COMPOUND are among this comprehensive collection.

It's Mac-Basic's specific functions that are the most interesting. Three things that strike me as being essential in a programming language for the Macintosh are: the ability to read the mouse; control of the windows and the graphics within them; and access to the user-definable pull-down menus. Two functions to read the mouse button, and two that return the position of the mouse within a window provide the necessary information for mouse-driven programs.

Providing you're willing to stay within the confines of output windows, the window and graphics commands are excellent. Briefly, PLOT displays individual pixels and lines, and RECT, OVAL and ROUNDRECT display rectangles, ovals and rounded rectangles respectively. The speed at which these are drawn convinces me that these are calls to the respective ROM routines. You can fill outlines with a variety of patterns using PATTERN, and can also invert(INVERT), outline(FRAME) and erase(ERASE) them.

Graphics are drawn by an imaginary pen. PENPOS determines this pen's position within a window, and PENSIZE determines the size of a single mark or dot. PENMODE can provide hours of fun by performing logical operations upon the overlaying of two patterns.

A GPRINT statement allows the selection of a font from those available.

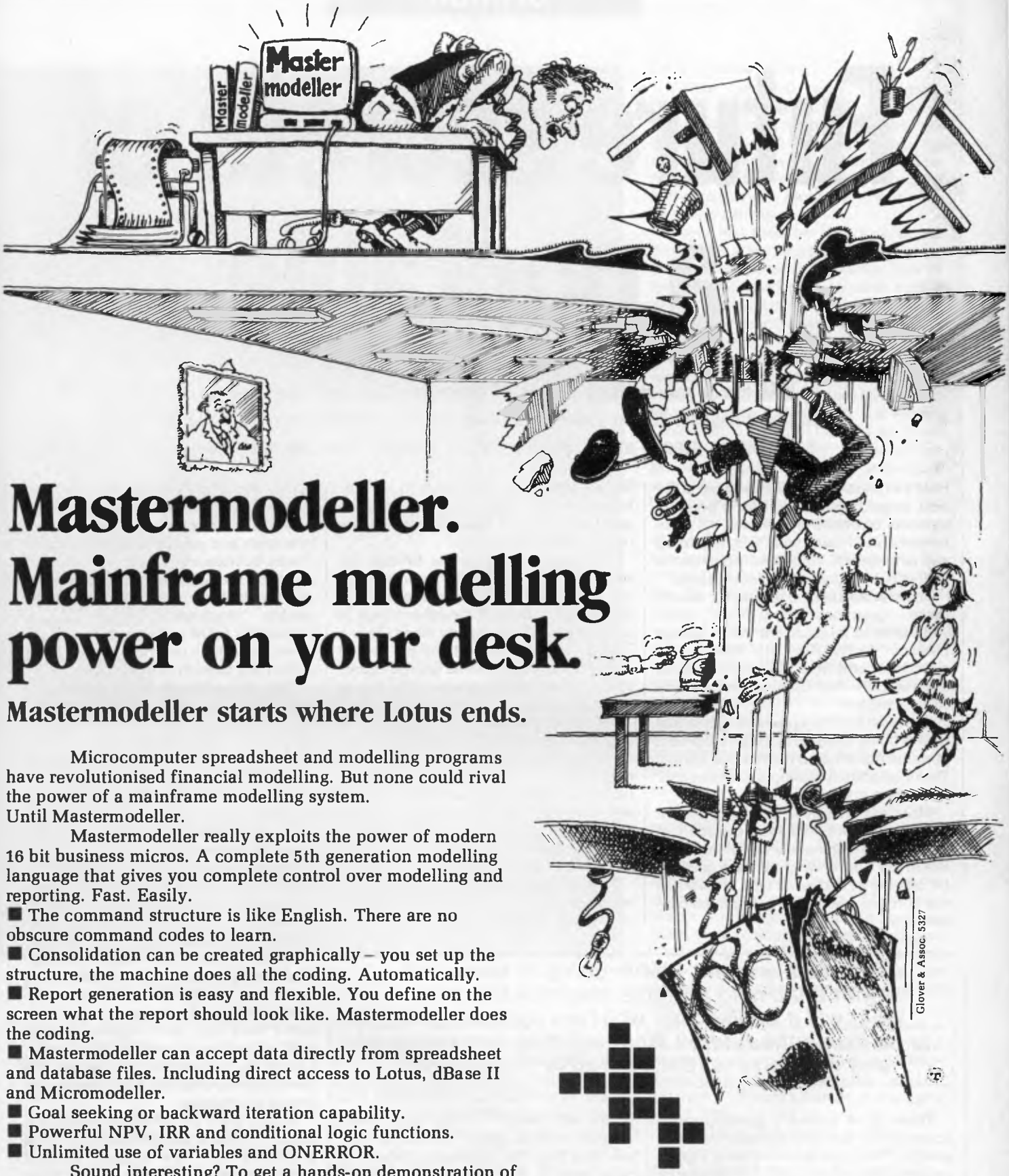
SET options are also used to control the size of the outputs window, with SET OUTPUT determining the size and position of the window and SET LOCATION defining the area to which the graphics displays are limited.

The most interesting of the window commands is SET SCALE, which determines the logical range of coordinates that Basic uses to draw graphics. Drawings can be made to dynamically grow and shrink. One drawback is that

Goto page 171

Data type	*Symbol*	*What it holds*
Boolean	~	True/false
String	$	Sequence of characters
Character		ASCII character number
Pointer	]	Address in memory
Handle	}	Pointer to pointer
Double-precision real	(none)	15-digit accuracy up to 1E+308
Single-precision real		Seven-digit accuracy up to 1E+38
Extended precision real		19-digit accuracy up to 1E+4932
Short integer	%	Four-digit accuracy up to +32767
Comp	#	18-digit accuracy up to +1E18

Fig 1 Mac-Basic data types



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Future secrets of a portable

IBM has a new portable computer, codename Clamshell, under wraps. Regular columnist Martin Banks speculates on the machine's size and shape, and looks in general at the development of portables over the next decade.

Here's a question for you: just what is the best target configuration for a portable personal computer system for 10 years hence? Specifically, what will its size be and what will its functional capability be like, and will it still be PC-compatible?

There is no specific reason for asking these questions now, no great watershed is foreseen for 1995 except perhaps World War VII. Rather, the questions come from a number of events and rumours that have occurred at the same time.

The main rumour is the strong one that IBM is going to come out with a lap-held portable machine sometime this spring. This immediately prompts the question: 'What is it going to be like?'

More importantly in the long term, it poses the more nebulous question of what systems generally are going to be like in the future, what they are going to be capable of and what type of package the portable machine is going to be contained in.

Rumours are that IBM is going to come out with a lap-held portable machine this year. What will it be like, and what are systems going to be like in the future? What will they be capable of and what size is IBM's portable going to be?

There is, of course a growing move towards the lap-held portable machine already. The Data General One is a good example of the trend, with full 25 row by 80 column LCD display, one or two micro floppy drives and battery operation. The weight, at 4kg minimum, is still a trifle bone crushing for a true lap-held machine while the price, at over $4,500 for the minimum configuration, is probably over the top. It gives the user a good idea of the direction things are moving in, however.

Then again there is the Sinclair QL which, while being neither a portable nor a PC-compatible machine, does demonstrate some of the other trends in technology. The company claims it is a 32-bit machine, though others would suggest that the Motorola 68008 is only an 8-bit processor by virtue of having an 8-bit data bus.

Be that argument as it may, what is important about the QL is that it gives software writers a direct route into the next area for development — real 32-bit processors. Motorola has such a device on the stocks, called the 68020, and its prime claim to fame for QL software writers is that it is directly software compatible with the 68008.

This is important because 32-bit systems will have one capability that an increasing number of application programs will need — a very large direct memory address space. To be sure, they will also have the processing power to cope with it, but the space itself will be important.

All that space will be used for lots of lovely systems software that will provide the wide range of housekeeping facilities needed to make computers actually live up to the often-abused title of 'user-friendly'. There will also be extensive use of such techniques as virtual memory operation and good old graphics icons. These facilities are already here in abundance on the Apple Macintosh. They are now available for the IBM PC and compatible machines through Digital Research's *GEM* software package, and will soon enough be coming from Microsoft in the form of *MS-Windows*.

This groundswell of iconisation in software is one of the better ways that the computer industry has come up with recently to make systems more friendly and usable, and the one thing needed (as has been found with the original Macintosh) is a hell of a lot of memory to be available.

Couple this with a trend that some see towards more multi-user applications, especially where one or perhaps two dumb terminals are hung onto a powerful system like a PC AT, and the need for available memory will become paramount.

However, there are those, Microsoft founder Bill Gates being not least among them, who feel that this particular multi-user scenario will not happen in practice. Gates feels that this 'organic' growth path of multi-user systems will be prejudiced by the amount of memory the new graphics-oriented applications programs will require.

Others, such as US-based consultant Richard Matlack, see considerable future growth in multi-user systems. Matlack also sees the introduction of *Top View* and the *Decision Series* of applications packages from IBM as a significant move by the company towards 'standardising' the whole of the business market for personal computers. While standardisation

has its very definite advantages in some areas — hardware architecture and operating systems being two of them — there are other areas where it can be a hindrance.

Speaking at a *Financial Times* sponsored conference last year, Matlack suggested that the trend towards the 'standardised' integrated applications suite was a bad move, both on the part of the industry and, more specifically, for users. Future systems will see less of this, he feels, as users appreciate the need to individualise their own applications' requirements.

Unfortunately, in the realm of the portable machine the trend is likely to be the other way at first, as the temptation to build applications software into read-only memories and integrate them into the system hardware will be very strong. To do this at present requires well-proven bug-free software, for it is an expensive process to 'fix' programs into ROM in this way, and corrections or modifications can cost a fortune. The obvious disadvantage of this is that it promptly reduces any operational flexibility to virtually zero.

Within our 10 year time-frame, however, the programmable versions of ROM, especially the versions that are erasable, and then reprogrammable, will come into their own, as will the programming machines that will take the original software and 'blow' it into the firmware packages.

Users will then be able to gain the integration advantages of firmware while retaining the flexibility of choice. And for those who would then say that such a motley collection of different applications would be un-integratable (if there is such a word) then Bill Gates has an answer, which he put forward at that same *FT* conference.

He sees commonsense being built into operating systems in the future. There would be what he calls an 'intuitive' aspect to the system whereby it can get to recognise common patterns of operation by the user and start to carry the patterns out automatically.

So, if 'integration' means marking data in one file, creating another temporary one to store it and then transferring the stored data to a marked spot in another file, the system will learn this and do it automatically.

Gates sees such a system being capable of learning to spot common keying errors of such things as file names and learning common procedures such as organising daily back-up routines.

So, given that IBM is likely to introduce a lap-held machine this year, what type of portable machine will be available in 10 years' time and what features will it have?

The chances are it will have most of the capabilities mentioned here, except for the multi-user aspect. There will almost certainly still be compatibility with PC applications as well. It will be a multi-tasking, virtual memoried, 32-bit processor with programs in programmable ROM, with a colour graphics LCD display (there's a guess if ever I had one) and dual megabyte micro floppies (or perhaps one micro Winchester of 20 megabytes).

What about the size? Well, I have a book at home called the *Dictionary and Guide to Microcomputers and Microelectronics*. It measures around 250mm x 160mm x 40mm, and weighs just 1.25kg. It sits on my lap nicely, without doing permanent damage.

These dimensions give enough room for a keyboard and, more importantly, enough room for some other form of input/output interface, such as a tracker ball. Put the display in a fold-out top and there you go.

Well, we shall see, won't we?

MICROTEX 666

Taking advantage of Telecom's Viatel, Computer Publications provides a refreshing new use for microcomputers, Microtex 666. Rekindle the fun you had when you first bought your micro or take advantage of the serious applications Microtex 666 makes available. Steve Withers elaborates.

It was sometime after the launch of British Telecom's Prestel videotex system that any special services appeared for micro users, but the Australian microcomputing community is more fortunate. From day one of Viatel, Computer Publications (publishers of *APC* and *PCG)* has provided such services.

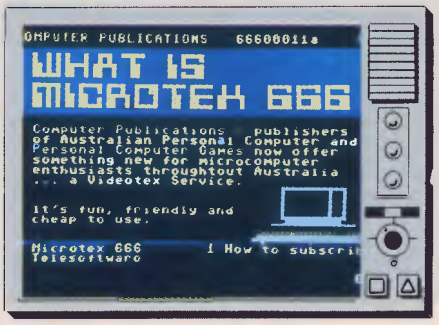
The service goes by the name Microtex 666 — the first page is Viatel frame 666 — and at present the pilot service is available to all Viatel users. The initial offering represents a subset of the facilities that are under development, but the idea is to give prospective subscribers a taste of what's to come. The bulk of the material will only be available to those who have paid a subscription to Microtex 666 — in videotex terms this is a "closed user group", and the mixture of public and private material is not uncommon.

The section of greatest interest will probably be the downloadable software library. The initial selection is primarily for testing purposes and consists of four programs for the Commodore 64. Once the full service starts there will be hundreds of programs covering the popular home computers (Commodore 64, Apple II, BBC Micro). Owners of IBM PCs and other MS-DOS computers will be well catered for with both business and recreational software, and demo models of the latest business software can be downloaded. The idea of downloading software by phone is nothing new, but the use of Viatel means that communications costs are limited to a small charge of 8 cents a minute peak time, and only 5 cents a minute off peak, wherever you live in Australia.

As Viatel is essentially the same as Prestel, it's not surprising that the downloading protocol was developed in the UK (by the Council for Educational Technology). Each frame ends with a checksum, and if any transmission errors occur the particular section can be

By "multi-player" the designers don't necessarily mean the usual half-dozen participants, as games involving as many as 1000 players are planned.

1



2

3

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3 Apply the wisdom of our panel of experts or be an expert yourself and solve a fellow user's problem.

4 Just some of the categories of software available to you on Microtex 666.

5 A small sample of the hundreds of software programs waiting to be downloaded.

6 Software downloading is easy: just two fingers and the program of your choice is shot down the line.

7 Message time. Contact friends or talk to Microtex 666 — it's faster than the mail, and cheaper too.

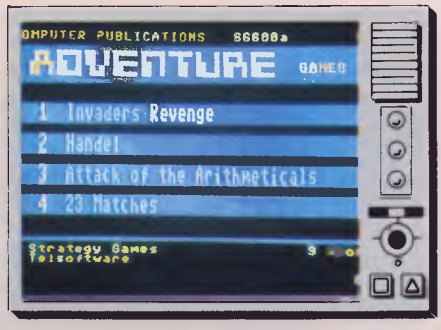
retransmitted from Viatel's frame buffer, minimising the load on the host computer (this is why no charge is made for a repeat transmission of any frame). I've been told that this protocol may be adopted by Telecom as *the* standard for downloading from Viatel.

From the user's point of view, the big advantage of this protocol is that it is built into most (if not all) Viatel adaptors for micros. I'm using an adaptor for the Commodore 64 made by Tandata (distributed by GEC Australia) and all you have to do is press "T" while holding down the "Commodore" key. The firmware does the rest. With this particular system the result is a data file containing the program.

The original four programs are "Invader's Revenge", "Handel" (plays a classical tune), "Attack of the Arithmeticals" (mental arithmetic drill in a space invaders setting), and the classic "23 Matches". I admit that they aren't particularly original, but they are fun. Most of the programs appearing in *APC* and *PCG* will be added to Microtex 666 — subscribers will be able to download some without charge, others with a charge commensurate with the program's quality. The average charge for particularly long or high quality programs (including some that won't appear in print) will be in the vicinity of $5. That's far cheaper than buying a cassette or disk. Many of the industries more innovative software distributors will be supplying commercial software for downloading on Microtex 666. For those of you who have downloaded software from RCPM or similar systems at 300 baud, Viatel's 1200 baud transmission speed will be a great relief.

By the way, if you have a collection of programs from *APC* or *PCG*, or any programs you have written yourself and would like to earn some easy money from royalties, contact Gerard Kohne at Computer Publications' Melbourne office (see the contents page). In most cases the machine-readable copies have been returned to the authors, so the loan of some tapes or disks could save him a lot of keyboard work, and he'll make it well worth your while.

4



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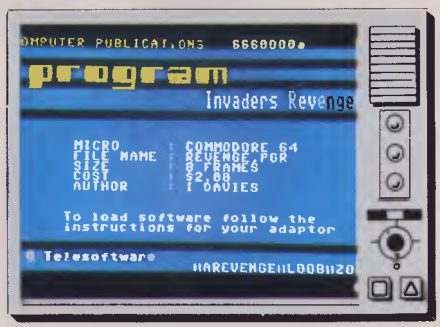


6

7

"Tips and Hints" will be another major part of Microtex 666. All sorts of useful information about popular micros will be presented. Once again, the pilot service caters for the Commodore 64, but expansion is imminent (and may have happened by the time you read this). As with the program library, charges may be made for frames in this section.

Microtex 666 will soon include a question and answers section. The idea is that subscribers facing specific technical problems can seek help from those with expertise in that particular area.

Several other services are being prepared. I'm looking forward to the multi-player games that are being developed. By "multi-player" the designers don't necessarily mean the usual half-dozen participants, as games involving as many as 1000 players are planned.

A bulletin board is being set up, and again there's nothing extraordinary about it, but just imagine the implications of a BBS accessible to all Australian enthusiasts without the expense of STD calls! Listings of goods wanted or for sale will be accepted by Microtex 666. While advertisements can only be placed by subscribers, all Viatel users will be able to read them.

Microtex 666 will also contain advance information about future issues of *APC* and *PCG*, plus lists of back issues. Users will be able to order subscriptions or back issues of either magazine.

Bear in mind that the full facilities of Viatel are also available — private electronic mail, telex links, teleshopping, and home banking are just a few of the services offered by Telecom or other information providers.

By this time you're either interested or you've already stopped reading. To find out how to subscribe to Microtex 666 simply turn to page 90 where you will find everything you need to know. Don't worry if you don't yet have a videotex adaptor, as Computer Publications has arranged package deals for the owners of popular micros.

I'll be back next month to bring you up to date with developments on Microtex 666.

Don't let figures

A spreadsheet can help you improve your business, but used wrongly it can create dire problems. Jonathan Batson looks at spreadsheet accuracy in general, and John Spittal follows with a step-by-step guide to making sure your spreadsheet gives realistic results.

Recently the *Wall Street Journal* reported that a Dallas-based oil and gas company had fired several executives for oversights costing millions of dollars in an acquisition deal. The errors were traced back to faulty financial analysis in a spreadsheet model.

This was a rather drastic consequence of not checking a model thoroughly, and usually major errors are caught before it is too late. However, many people have had narrow escapes and there are plenty of other horror stories.

Since VisiCalc's appearance in 1979, the spreadsheet has become probably the most widely used microcomputer program. As memory sizes grow, spreadsheets grow too and become more complex. Rounding .06 to 1 can have unforeseen and unfortunate consequences in a 15,000-cell spreadsheet dealing in millions of dollars. Taking the print-out as gospel and using faulty figures to make critical business decisions is an increasing problem.

So how can you avoid making mistakes in vital calculations?

There are good practice ways of working which do not slow down the development of models. By applying them some of the problems encountered with spreadsheets may be avoided.

Typical spreadsheet problems include:
(a) a logically inconsistent model — where two or more parts of the model are not consistent;
(b) a conceptually flawed model — where wrong formulae are reproduced throughout the model;
(c) data format is inconsistent or garbled — where, for example, some data is in man hours, some in man days and other is man months;
(d) the wrong tool — where the problem has been modelled incorrectly.

Our suggested development methodology is based on commonsense rules, but ones which could be forgotten.

1) You need to understand the problem, define it precisely and highlight the interactions of the variables being analysed. The data to be used within the model should be identified as well as the likely results.

2) After this a technical design phase is needed where you decide the practicalities of which computer and which particular piece of software to use. The overall layout of the model, including where the data will be held and the form of the reports, should be examined.

3) The next task is the writing of any algorithm, such as an allocation rule, and then the detailed translation of the technical design into the individual formulae. The more carefully and efficiently the technical design has been done, the easier the coding task.

4) To be sure there are no errors within the model, rigorous testing must be carried out. This will probably include the use of historic data, if this is relevant, so you can check the model's results against figures you know to be correct.

5) While the development has been taking place you should document what you are doing. Likely parts of this are listings, design assumptions and data used to

catch you out

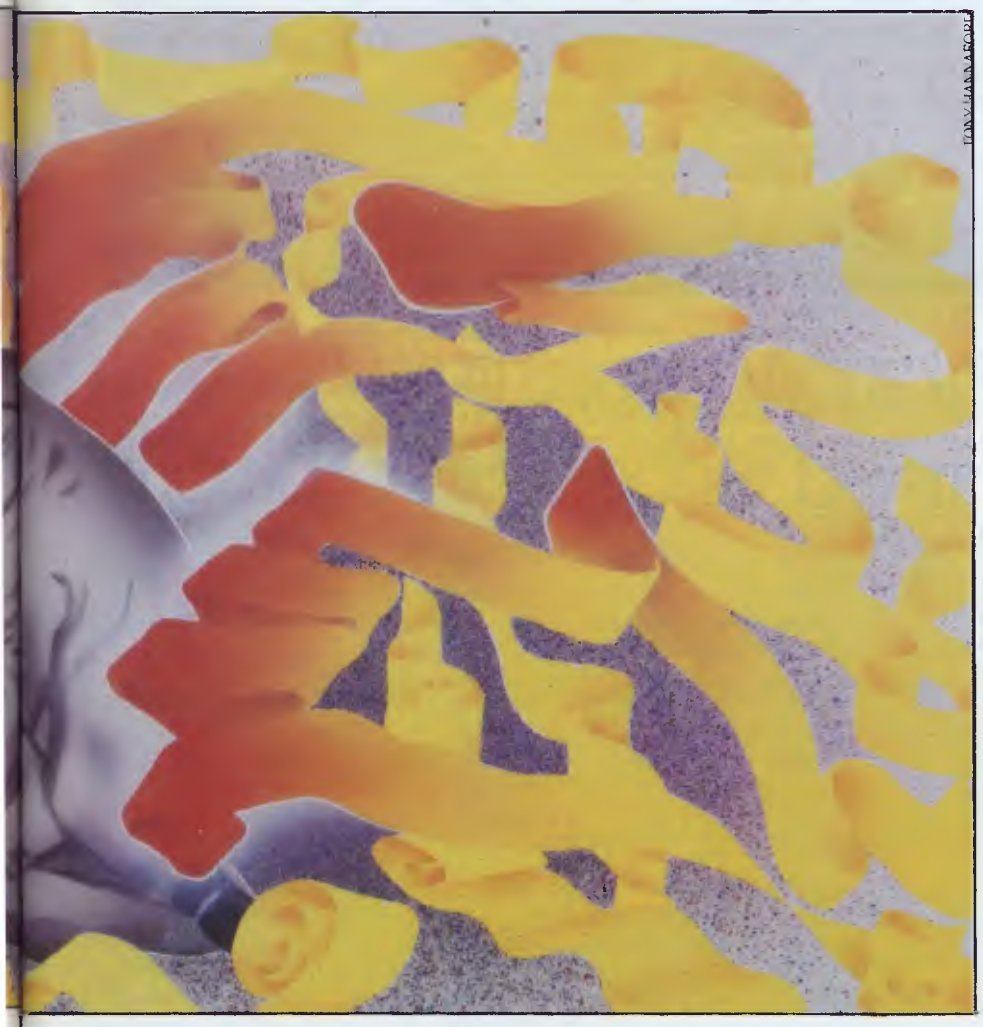
test the model. Also, if the model is not going to be used by you, then a User's Guide and Operating Instructions are needed to help the user.

6) Eventually the model is ready to use, but a disciplined approach is still required. You must check the data input to be sure that it is in the form required. For example, if some of the data is in metres while some is still in feet, care must be taken to ensure you convert it into the correct form. Once the data is all in the same form, it must be input correctly. Even minor changes to the logic must be documented. Finally the output from the model should be examined and a watchful eye kept to ensure that the anwers produced agree with common sense.

An audit trail to show the model's author, date of creation, unique name and its purpose are necessary, especially if it is used by another department. Making someone responsible for the spreadsheet will ensure more disciplined and intelligent use of it.

What are the practical implications of this? The first question is whether the spreadsheet is the most suitable tool to use. Problems are sometimes made more difficult by trying to solve them using software which, although familiar to the user, is not the most suitable.

After deciding that the spreadsheet is really the best approach, is the model to be developed via a prototype (to see the 'sort of thing')? Problems can arise when the prototype model becomes the basis for the main model, since short cuts may have taken place in producing the prototype. It is therefore vital to document clearly all assumptions made, detailing any variations from 'reality' and their effect on accuracy.



The level of detail of the model should also be decided at this stage. There is a tendency to include as much detail as possible, which is often counter-productive. For example, a spreadsheet of say 20 columns and 200 rows is generally too big for easy comprehension and the quantity of numbers displayed may only confuse or give a false level of accuracy. As spreadsheets can now be consolidated (eg enabling divisions of an organisation to be brought together), this must be thought about at this stage.

After you have understood the problem and specified it analytically comes the detailed design. Will the model fit on the computer available and does the intended spreadsheet have all the facilities required? For example, if graphs of the results are required, will the chosen spreadsheet provide them itself or will it link with another package?

Good design work produces an easy-to-use model. Splitting the data input into blocks, for example, allows for easier input and checking. Also, such practice enables easy data linking between sheets. It should not be forgotten that the sheet will be examined through a VDU and on hard copy. (When using a VDU the user prefers to work up/down, while on paper there is a tendency to read across the page.) This separation of large spreadsheets into blocks is an excellent way of emphasising break points. Such break points may represent decision points where the user must choose one of several possible options before proceeding to the next module.

You need to decide the order of calculation by column or row, as it could affect the results produced. You should not go back on yourself by referencing cells appearing above the formula, as if this does occur incomplete calculations may happen. If this is unavoidable then ensure that the recalculate button (!) is pressed several times before using the results.

When the design of the model is complete, you can start coding up the formulae. The most common problem here is that when using the replicate command, it is very easy to make a mistake

and not give the correct cell references. This is one of the advantages of the newer packages such as Lotus 1-2-3, which allow you to 'point' to the relevant cells with the cursor. Even so you should also check the formulae afterwards. If totals are produced, and a grand total calculated from the addition of a set of row sums, then if possible cross-check by also calculating the column sums. To be sure that you know when an error occurs an 'IF statement' can be used. For example IF (A=B,A,ERROR).

A spreadsheet model must not be used until it has been checked — the results it produces must be realistic.

Beware rounding! Do not use it as an excuse for an inaccurate or logically incorrect spreadsheet model. The level of accuracy to which any number is calculated should be known, as well as the impact this will have. For example INT (10*C22+0.5) /10 will round values to one decimal place. Rounding values may have a knock-on effect in later calculations.

So the spreadsheet model is now finished and ready for use. However it must not be used to obtain results until it has been fully tested. Its results should check against the real world. Even if the arithmetic is correct, if the spreadsheet does not give realistic results then it is not useful. When the model is completely checked the formulae can be 'protected'. This stops formulae being overtyped with data by mistake.

While you are doing this, documentation is going ahead. This will include a print-out of the model, and a new one should be obtained each time the model is changed. The 'recipes' (that is formulae) should be kept with ideally two or more columns and any total column to ensure that replication has taken place correctly. These 'recipes' should be referenced to the models they relate to. A record of the changes to the spreadsheet and information about why they occurred should also be included.

Alternatively, when the spreadsheet model does not take up all the memory of the computer, some of the vacant areas could be used for documentation. For example, the rules of the model can be entered as text in columns BA to BK. When you are happy that the model is logically correct, the formulae can be copied over to the left hand side of the sheet. The spreadsheet is therefore self-documented. If the model is changed for any reason, it is very easy to change the documentation since it is only a few columns away.

The date used in the model should be retained, including the basis of any forecasting routines. The names given to the spreadsheets should be helpful, so as to understand the origin of the different models. Similarly if the data is stored on file, names such as DATA1, DATA2 should not be used.

This kind of technical documentation becomes particularly important if the spreadsheet model's technical development/modification is passed to someone who did not initially develop it. if the user is not going to be you, then operating instructions will be needed immediately.

Finally, the model can be used in earnest, with confidence that the mechanics of the spreadsheet produce what they should. However, care is still needed to be sure that the data is input correctly. The results must also be checked to ensure that they are sensible and that the spreadsheet modelled the correct problem. One aid when examining spreadsheet models is to have a column which says whether the row has been input, calculated or copied from another part of the sheet. Using the abbreviations I, C, COP can be very helpful when examining a large model.

So is all this extra effort worthwhile? Aren't spreadsheets supposed to be used for 'quick and dirty' model development?

If serious problems are being tackled, then no matter how cheap the software, a disciplined approach is needed. Do you want to be the person who costs the company thousands or millions of dollars because of a faulty spreadsheet model? There are already people who wish they had not taken the risk.

So you know it's crucial that your spreadsheet is accurate, but how do you ensure this? John Spittal has suggestions.

Let us begin with system design — the process of converting some company function into a mathematical formula. Now most users start to develop financial models from the data, designing formulae to process it and finally producing reports. While this is logical, it lacks the emphasis posed by the questions: What do I need? What are the important accounting ratios? What are the objectives and constraints?

So I recommend defining the output first, to identify the simplest route to developing an effective business model with the minimum amount of data. The following outputs are among the most important:

rate of return or yield
cash flow
contribution per unit
profit (gross, net before tax, net after tax)
breakeven point
payback period
earnings per share
return on capital employed
tax
assets
loans and borrowings
gearing

After the model has been designed to fit the business objectives, the input data needs to be determined. The data should be analysed and reviewed for its

Table 1

Rounding errors

	Data	*Percentage Calculation*	*%*	*Pro-rata $500 million*	*%*	*Pro-rata $500 million*
	14	$\frac{14}{44} \times 100$	31.8181	159.09	31.8	159.00
	9	$\frac{9}{44} \times 100$	20.4544	102.27	20.5	102.50
	5	$\frac{5}{44} \times 100$	11.3636	56.82	11.4	57.00
	16	$\frac{16}{44} \times 100$	36.3635	181.82	36.4	182.00
Column Total	44		99.9996	500.00	100.1	500.50

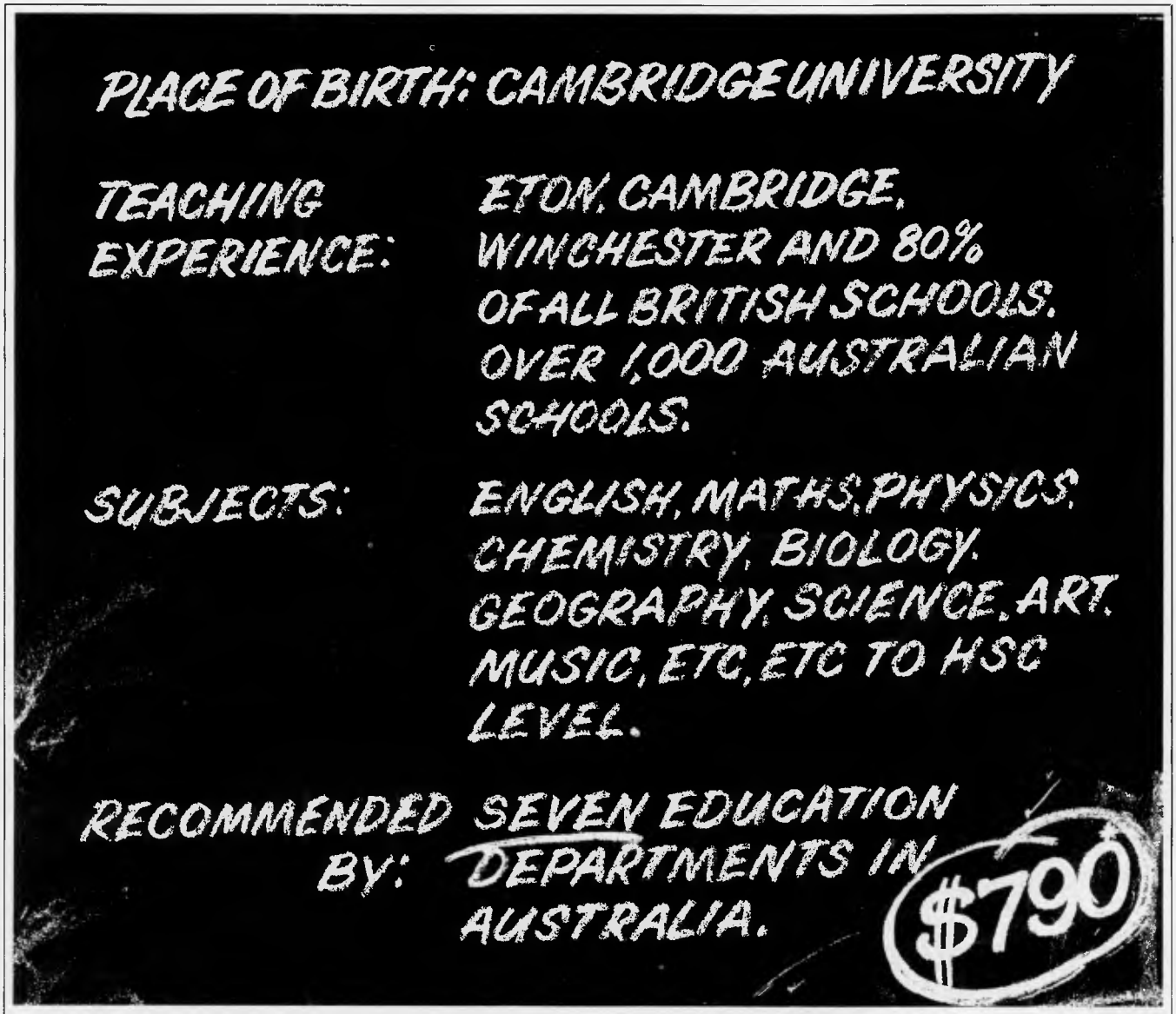


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Table 2

Formulae errors

Formulae	Intermediate calculations	Results
A : A1 = 125 x 100; A1/17	125 x 100 = 12,500.0 (to 1 dp); $\frac{12,500}{17}$	735.3
B : B1 = 125/17; B1 x 100	$\frac{125}{17}$ = 7.4 (to 1 dp); 7.4 x 100	740.0

Actual answer: $\frac{12,500}{17}$ = 735.29411

accuracy, limitations and reliability. If the source data is based upon false assumptions then no matter how accurate numerically, the output will be misleading.

Inadequate costing systems are a prime source of unreliable data especially in small firms, which either have no integrated accounting procedures to reconcile the financial accounts with the management accounts, or have weak budgetary controls.

Some of the other typical misconceptions are:

i) standard costings which bear no relationship to actual or audited results;

ii) rigid adherence to full absorption costing when plant utilisation is low;

iii) accounts which incorporate assumed (high) margins;

iv) grossly overvalued stock, for example the garment manufacturer with high obsolete stocks of cut, narrow material which is only suitable for miniskirts during a period when long skirts are fashionable.

Whereas costs are generally capable of reasonable assessment, levels of sales are much harder to forecast. If one doubles the costs and halves the sales, then one stands a much better chance of forecasting results which are closer to reality.

Three common idiosyncracies or 'computer errors' which often arise from the use of the model's parameters are rounding, formulae sequence, and truncation.

Truncation may be avoided by setting the column width, and the other two idiosyncracies by setting the number of decimal places to an appropriate large value.

Rounding errors

Table 1 shows a simple summation where a line is expressed as a percentage of the total and is rounded to the number of decimal places shown. Then the percentages are applied to $500 million. The results in the table speak for themselves.

The computer accurately adds the columns but does not follow the common practice of making percentages exactly 100%, by adding or subtracting from the largest number.

Formulae errors

A variation involving rounding of intermediate calculations is shown by the formulae in *Table 2*. It shows the same calculation performed in different sequences. If each result is rounded to one decimal place (dp), then sequence A gives an integer intermediate result (12,500), but B rounds the answer to 7.4 and the rounding error is multiplied 100 times.

To overcome this problem, the general rule is multiply first, divide last and extend the number of decimal places.

Truncation

Table 3 shows a summation and a column width setting of three. If the table were incorporated in a mass of figures, then at a glance one may miss that there is an 'error' of 1,000, because the answer is 1,942, a four figure number. The computer calculates the sum accurately, yet the result is presented through a 'mask' which hides the missing digit. It is not reported with any error or warning message.

Many microcomputer and mainframe modelling packages work this way. Therefore, check that grand totals extend at least one or two digits beyond the detail line.

Signs

Do not store debit (asset) amounts as positive and credit (liability) amounts as negative. Double entry accounting is confusing, especially in a model. It may appear convenient to let the computer show the sum of the accounts produces a zero balance. However, I recommend that you only use positive values and subtract liability from asset instead. It is all too easy to miss a sign and create a wrong answer.

When you have followed these steps, ask an independent person to review the data, the model and the results. This person should spend at least several hours on the review — it should be more than just a quick flick through the results. You will be surprised at the problems an outsider might see just because he has not been as closely involved with the whole project as have you.

Table 3 Truncation

1	5	9
8	1	2
4	7	8
4	9	3
9	4	2

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Spreading the word

Messaging facilities play an important part in the concept of portability. Menno Aartsen takes the weight off his arms to examine exactly what constitutes a portable machine, and looks at the electronic mail systems portables can talk to.

The gap is widening between portables which try to emulate desktop machines and those which aim for true portability. The recent introduction of the Apricot Portable is a perfect example: it's a powerful MS-DOS machine, containing everything the computer user needs. A mini-floppy and a full-size screen make it completely independent, anything from Lotus 1-2-3 to an accounting package will happily run on it, and it can be moved from work location to work location quite easily. Yet it's not a true 'portable' computer, a term better reserved for lap held machines. The Tandy Model 100, in particular, has done much for true portability, although some people still think of it as a toy.

A journalist's toy, I should add — journalists were the first true users of the little 100, which enables stories to be written on the spot, on the train and on the plane, and then transmitted to base either direct or via an electronic mail system such as OTC's Minerva and Telecom Australia's Telememo service, due to be available at the end of this year. Many more professions have discovered the possibilities of these electronic notepads and found that they are quite powerful in their own right. A Tandy 100 with 23k of RAM will yield around 29k of user memory, with Basic, a simple text editor and a communications program in ROM. The Epson PX-8, on the other hand, is even more powerful and sports CP/M (with utilities), WordStar, Portable Calc and a scheduler. It has 24k of user memory (which runs out very quickly once WordStar starts creating backup files), supplemented by 29k on microcassette.

But where Tandy has attempted to create a portable with optimum usability, Epson has tried to emulate a desktop computer. The Tandy 100 is the more useful machine, despite the Epson's 80-column by 8-line display where the 100 only offers 40 columns.

Pocket micros

We'd all like a powerful micro in our pockets, but every extra carries weight. As a journalist I've carried both machines for days on end, covering exhibitions or attending conferences, and started to notice the weight very soon — after all, one usually carries more than just the micro. With acoustic coupler, the usual paperwork, keys and other bits and pieces, a case can easily weigh in at 10 to 15lbs, which is a lot to carry around all day. In this respect every ounce counts, which is where the Tandy (just over 3lbs) wins easily.

Although Epson has produced a very nice little machine, I can't see the need for PIP and CONFIG in a lap held. Epson does produce a battery-driven floppy, but with four software packages on ROM, built-in microcassette and RS232, I don't really need additional storage space. Once you progress to large files and other software it's surely better to buy a 'full' portable, considering the fact that a PX-8 with two floppy drives, diskettes, coupler, cables, spare batteries and charger can hardly be called 'lap held'.

But it all depends on what you expect to do with a portable, of course. Where the Apricot will happily give you an office computer in any location with a convenient AC socket, the true lap held allows the user to access electronic mail systems and remote databases, or even the office computer. The US company Dialcom,. now owned by ITT, started the craze with a viewdata system which could be dialled from within the US, and which would accept text output of, what were then, communicating typewriters, or teletypes. You could leave a message for someone else, receive your own and browse through information pages.

Today, the US alone has dozens of these ASCII databases — no graphics, no colour, the simple standard keyboard character set and lots of info. They vary from CompuServe in Columbus, Ohio, where one finds mostly computer enthusiasts, via The Source in McLean, Virginia, where thousands of teenagers

make each other's acquaintance, to Dow Jones News/Retrieval, where stockbrokers can find trhe latest quotes and read *The Wall Street Journal.*

There are very few 'true' message systems in the States. The latest arrival on the scene is MCI Mail in Washington DC, which offers a gateway to Dow Jones but only provides a mailing service itself. It will allow the user to send surface mail, however, from ordinary two-day post to a four-hour courier delivery in any major population centre in the US and Canada.

Which brings us home to OTC Minerva and Telecom Telememo. Minerva is based on ITT Dialcom software and Telememo will use GTE Telemail software. Both are primarily intended for messaging. Minerva provides databases offering a world news service and an international airline guide. The major advantage of a service like Minerva is its link with the international packet switching network and telex. From the user's terminal other Dialcom systems all over the world can be accessed from any location.

Electronic mail

The Tandy 100 is a clever machine: it was designed for use with these electronic mail systems although you can happily use it as a word processor. Tandy's portable version of Scripsit takes only 4k (as compared with Epson's Wordstar, 32k) and has all the basic processor functions. On the road, however, where you're unlikely to be lugging a printer, its own text editor does handsomely. Provided you have an electronic mailbox, you simply dump the contents of your memory (for safekeeping) and continue working. Since all its internal data is, or can be, converted into ASCII code, anything from your diary to utility software can be transmitted via electronic mail and retrieved the same way.

It's unfortunate that neither Tandy nor Epson have found it necessary to provide built-in modems with their portables. Officially they say Telecom approval is a problem, but I suspect that preparing a modem card for a small market would make the machines too expensive. Every PTT has its own standards, and these standards are different in every country; only the USA is a big enough market to

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warrant the development cost. The American version of the 100 thus comes with built-in Bell modem and software for auto-dialling, automatic log-on and automatic data retrieval. All you have to do to read and download your mail or stock market quote is program it, plug it into the telephone socket and hey presto! — it goes away and does it.

But Australia can't have it, and that's final. Even if you do get your coupler, modem and terminal emulator, you're not always home free. Australian buyers of Epson's PX-8 soon noticed that when they started using dial-up services, the terminal program either 'throws' you or simply doesn't work. Why? Epson isn't saying, but I suspect the software contains a modified American terminal package. This was originally intended to work with a bolt-under Bell modem with its own port, while we have to make do with the RS232C port as the connection.

fall or a bucket of water without complaint (yes, both happened to me).

Don't go for a portable unless you really want a portable, and if you do, use it with a mail system. And don't get on electronic mail unless you've got someone to talk to, and if you do, be prepared to pay for it. OTC Minerva charges 25 cents per minute connect time (plus of course Telecom's connect charge). On top of this is the actual cost of data transmission if you're sending mail overseas; this is 13c per minute plus a date volume charge which for an average full page typed letter would be around 44 cents. So the cost to send a letter to the US would be of the order of one dollar.

Conclusion

Portable computing is good fun, and useful for some, but has a long way to go. You can't make a keyboard smaller and a larger screen does away with portability,

'The major advantage of . . . Minerva is its link-up with the international packet switching network. From the user's terminal, every ITT Dialcom user in the world can be mailed, and the system can be accessed from every location . . . '

Epson-to-Epson works well, but then that is not dependent on correct tones or voltages which differ in the American and Australian telephone network. Epson users who have experienced these difficulties might like to know that *APC* offers a (free) solution (see box).

The use of portables and dial-up services is really tied to professions — private use is simply too expensive. The Epson is a splendid little machine if you happen to have another CP/M computer, so file and software transfer become useful. The PX-8 is specifically configured to talk to Epson's own QX-10 desktop micro, but it wouldn't talk to my Rank Xerox 820-II although the latter would work as a terminal on the Epson. Other than that, you really need the memory expansion pack and/or floppies, both of which make the thing highly unwieldly. The Tandy 100, made by Kyocera which also supples Olivetti and NEC, will work as an intelligent terminal and has nice, big readable letters with true descenders, which is useful if you're writing on a train at night. It's virtually impossible to crash and will take a

so lap-helds will always be a compromise. Not until a portable with a large internal memory and a real fold-under screen is introduced will we really be able to carry our office around with us.

The Data General One is a step in the right direction, but we'll have to wait for cheaper technology and make do in the meantime.

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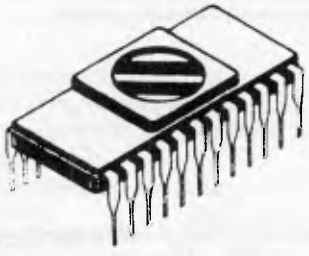

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On display

One of the most popular computer display devices is the cathode ray tube, but its dominance is under threat — the picture looks all set to change. Keith Brindley looks at the alternatives.

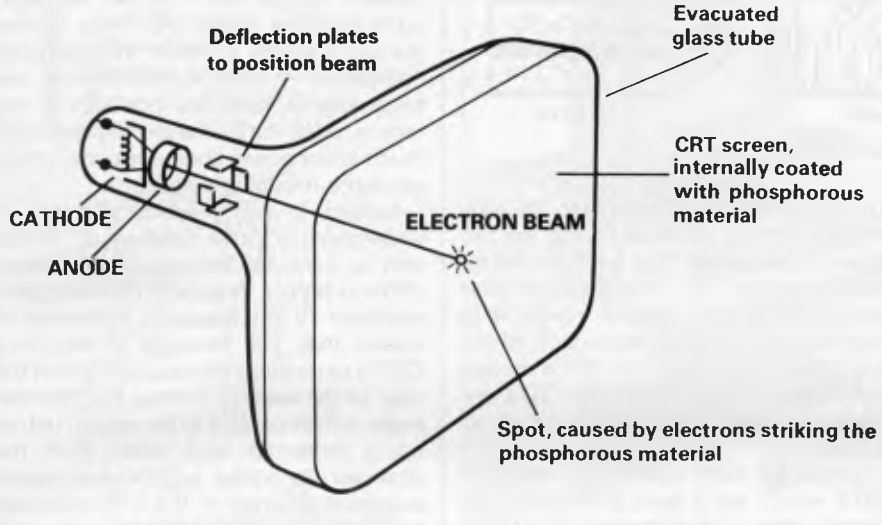

Fig 1 The CRT's evacuated glass tube

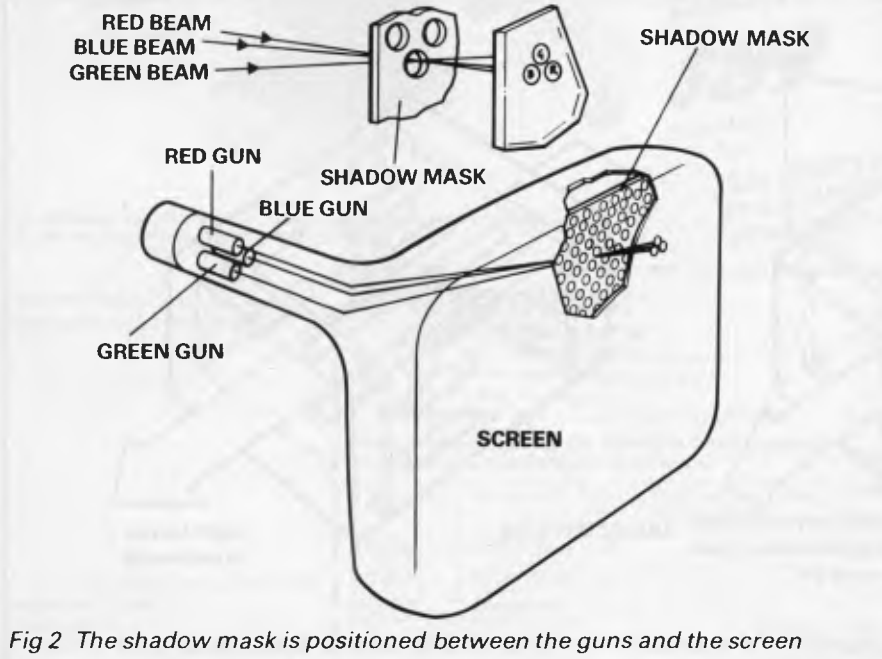

Fig 2 The shadow mask is positioned between the guns and the screen

The cathode raye tube (CRT) is the most commonly used display device in computers. Until recently it was also the only device capable of displaying TV pictures. However, the advance of smaller, lighter, cheaper and tougher computers has prompted significant research and development work into non-CRT-based displays. The main contenders in the race to replace the CRT are:

— liquid crystal displays;
— electroluminescent displays;
— gas discharge displays; and
— vacuum fluorescent displays.

Let's start by looking at the CRT itself. The term 'cathode ray' refers to the beam of electrons generated by a heated electrode (the cathode) in the CRT's evacuated glass tube (Fig 1).

The electron beam is focused and accelerated towards the internal surface of the screen of the tube, coated with a phosphorus material which glows when struck by electrons. A visible spot is produced on the screen, the brightness of which is dependent on the number of electrons in the beam.

By controlling the position of the beam and the quantity of electrons present, the position of the spot and its brightness is also controlled. Complete video pictures, graphics, alphanumeric displays, and so on, can be composed on the screen, with good clarity, in most lighting conditions, from a wide range of distances and from a wide range of angles, by moving the spot in a controlled way while altering its brightness to correspond to brightness variations in the displayed scene.

Spot brightness variation is a very important advantage of the CRT. Let's take the case where we can discern a definite number of possible individual spots (that is, pixels) on a CRT screen, in a matrix of, say 600 x 450 down the screen. (Flat-panel displays have a similar matrix of pixels, but individual pixels in these cannot be varied in brightness — they're either on or off. A flat-

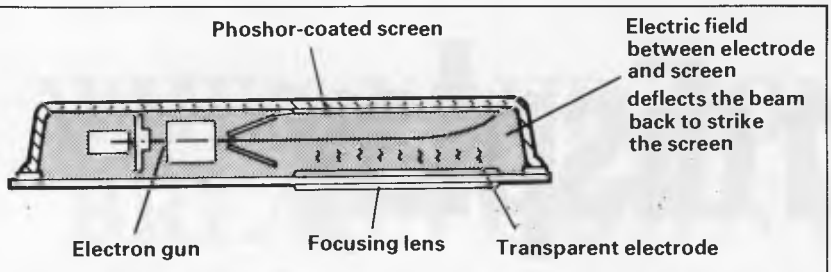

Fig 3 Cross-section of Sinclair's flat-screen CRT

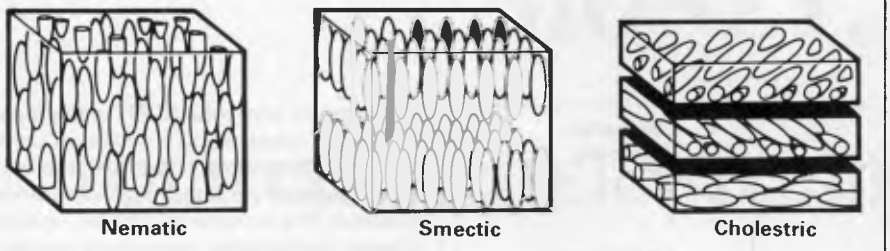

Fig 4 Differing types of liquid crystal molecule alignment

panel display which has the same number of pixels as a CRT and which can display scenes with the same clarity still cannot match the CRT's contrast variation over the scene.)

Colour displays can be made by replacing the single electron gun with three. Each gun of a colour CRT produces an electron beam which strikes phosphor 'dots' of only one of three colours: red, blue or green. To make sure each beam only strikes dots of its allotted colour, a shadow mask is positioned between the guns and the screen (Fig 2).

A CRT's display accuracy — the resolution — is determined initially by the size or pitch of the phosphor dots on the screen. But, in turn, this is governed by the accuracy of manufacture and positioning of the shadow mask: it is therefore, the shadow mask itself which is of prime importance to a CRT's resolution. Modern high-resolution CRTs are made with pitch sizes down to about 0.2mm.

Compared with typical TV standard CRTs, which are at least three times the former's size, such high-resolution CRTs are capable of great clarity and detail. Needless to say, the extra accuracy required in the manufacture of high resolution CRTs makes them much more expensive than the standard ones; nevertheless, they are used with a number of personal computers —typically IBM and Apple models.

The CRT's ability to display virtually any kind of colour or monochrome image to a high resolution, in a wide range of environments, has meant that it has been, and will be for a long time yet, the most used computer and TV display device. But it does have a number of significant disadvantages.

For a start, a colour CRT can consume anything up to 200 watts of power. Secondly, it's big — its depth is often greater then its viewing area dimensions — and heavy. And thirdly, it's not particularly rugged and can be damaged quite easily in transit. All these factors prevent the CRT's use in truly portable computers — and portable micros are becoming increasingly popular so the race is on to find smaller displays with much lower power consumptions, which are more robust and lighter.

Indeed, in this respect, the CRT is undergoing a certain upheaval. You've only to consider the use of flat-screen CRTs in Sony's Watchman pocket monochrome TV and Sinclair's equivalent to realise this. The principle of Sinclair's CRT is to position the electron gun at the side of the screen, so that the electron beam moves parallel to the screen before being deflected back away from the observer, to strike a phosphor-coated screen at the rear of the CRT. A cross-sectional plan view of Sinclair's device is shown in Fig 3.

A number of other manufacturers are

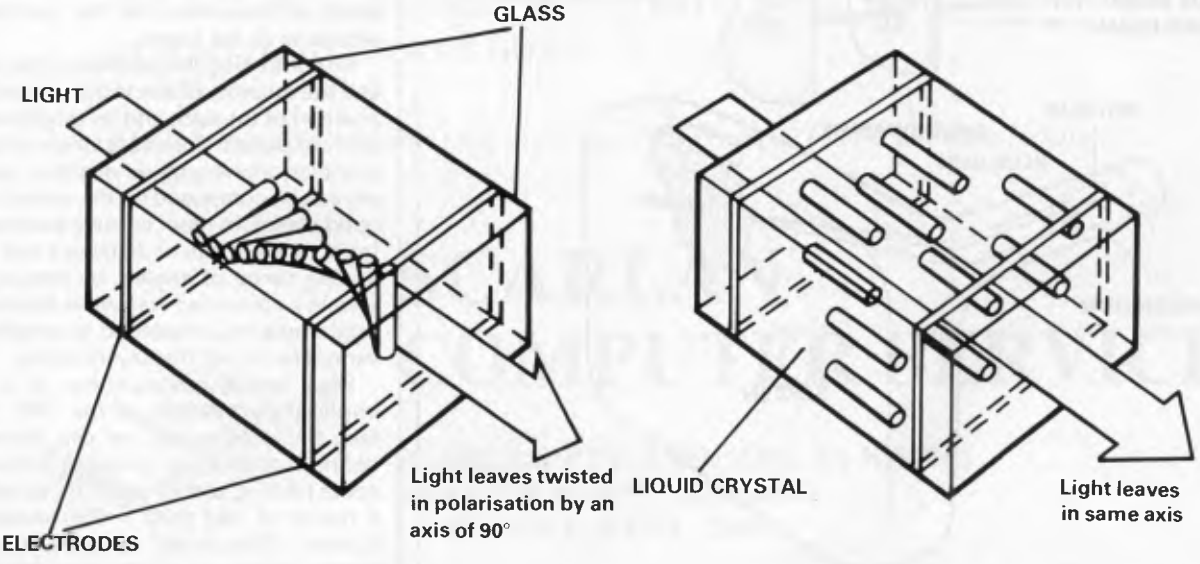

Fig 5 A typical LCD construction: a) with no applied voltage; b) with a suitable electrode voltage applied

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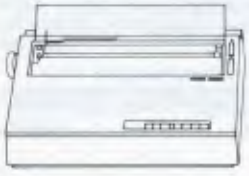

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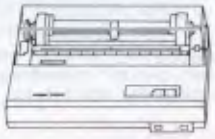

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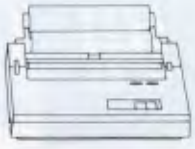

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notably Philips, and ITT with Siemens in a joint venture. The Philips CRT consumes only a few watts of power, too: a significant further advantage over conventional tube design. It will surely be just a matter of time before portable video recorders feature flat-screen CRTs.

Liquid crystal

Moving on to the newer flat-panel displays, as opposed to the flat-screen adaptions of an old CRT technology, the first flat-panel technology to take off and find usage in portable computers was the liquid crystal display (LCD). LCDs were initially used in lapheld portable micros such as Epson's HX-20, the newer PX-8 and Tandy's Model 100, although these micros are limited in the size of their display (the Epson PX-8 can only display eight lines x 80 characters). However, the micro market has recently seen the introduction of larger LCDs featuring, for example, 25 lines x 80 characters. The first true lapheld micro using this size of display (the LCDs are from Hitachi, incidentally) is Data General's One (see the Benchtest in *APC*, January).

No doubt as display manufacturers produce larger and larger flat-panel LCDs, they will be incorporated into micros. Interestingly, the first manufacturer to build a 25-line x 100-character LCD was Epson.

Liquid crystals are organic materials which are influenced by electric fields. Their name arises from the fact that their molecules are free to move (as a liquid's) but grouped in orderly fashions (as a crystal's). The variety of crystals most commonly used in LCDs consists of rod-shaped molecules, generally aligned in one direction. This variety, known as nematic liquid crystals, and a couple of others are shown in Fig 4.

A typical LCD construction is illustrated in Fig 5. Basically, a layer of liquid crystal material is sandwiched between two glass plates. The inner surfaces of these plates have transparent electrodes in the shape of symbols to be displayed. Symbols in LCDs used in micro applications are generally dots formed in a dot matrix display, and we can consider each dot to be a pixel.

'What we are about to see . . . is a break from the traditionally used CRT display device to the use of many other types of display. These displays will primarily be used . . . for a specific purpose . . .'

developing flat-screen colour CRTs;

With no applied voltage across these electrodes (Fig 5a) the liquid crystals naturally align themselves with the electrodes. In a twisted nematic LCD the electrodes are polarised at 90° to each other in the same plane, so the molecules closest to the electrodes are similarly at 90°. Successive layers of molecules gradually twist through the 90° difference between top and bottom. Light passing through the construction does so with a similar 90° of polarisation twist along the helix of the liquid crystal molecules.

When a suitable electrode voltage is applied (Fig 5b), the twisted nematic structure is broken and the molecules all become aligned along the light axis.

If a polarised filter is placed in front of the LCD, light of one axis will pass through and the pattern defined by the electrodes is invisible. In the other axis, however, the light will be blocked by the polarising filter and the pattern will appear dark. Thus, by turning the applied voltage on or off, the LCD symbol can be made invisible or dark.

Unlike most other display technologies, LCDs do not create light: they are passive and can only affect the way incident light is transmitted and reflected, so the brighter the surrounding light levels, the better the display appears.

This advantage brings with it, though, the resultant disadvantage of not being able to use LCDs in dark environments. Most of the recently introduced dot matrix LCDs have a backlighting option to allow use in the dark.

LCDs have other advantages; not the least of which is their extremely low power consumption (measured in fractions of a watt), low weight and small dimensions (about 15mm deep).

Present day LCDs, although still much faster than their counterparts of only a few years ago, have a response time (that is, the speed with which an element can turn from one state to the other) much longer than is required to allow, say, a TV picture to be displayed. Common response times are around 300ms — which is fine for alphanumeric or simple computer graphics displays, but not much else. Even the latest Epson display, mentioned earlier, is reported to have a response time no faster than about 180ms.

Future generations of LCDs, on the other hand, will probably include one or both of two additions which will reduce apparent response times and make them generally easier to use. Firstly, the addition of a thin-film transistor (TFT) at each junction between rows and columns of the matrix. The TFTs are used as fast acting bi-stable switches allowing the matrix to be rapidly addressed in a multiplexed manner, reducing the importance of the LCD's response time.

Secondly, a new technique, known as chip-on-glass technology, is being developed in which associated driver circuits are bonded direct onto the glass of the LCD. With chip-on-glass LCDs the external contacts will number only a handful: power supply and data. At present all the driving circuits are mounted on printed circuit boards placed immediately behind the LCD and many matrix connections must be made between the two.

Colour graphics LCDs are possible, operating by a number of methods. One of the most promising, pioneered by Seiko, uses coloured filters electro-deposited over each individual pixel's electrode. A pure white backlight shines through the LCD. Coloured pixels are arranged in groups of three: red, green and blue. By turning each pixel on or off, coloured light is transmitted or blocked.

It shouldn't take long to calculate that by turning on or off a total of three

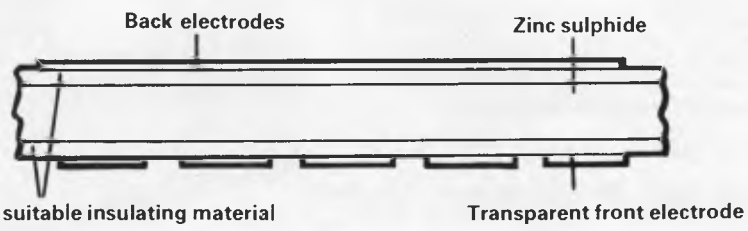

Fig 6 Basic electroluminescent structure

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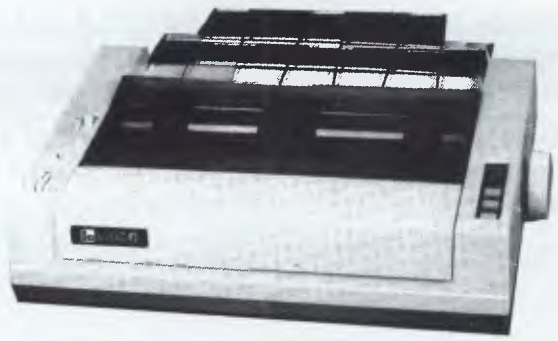

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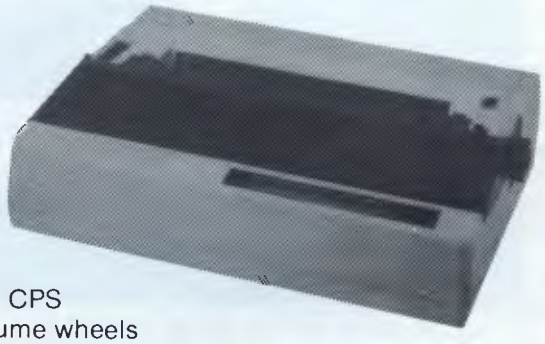

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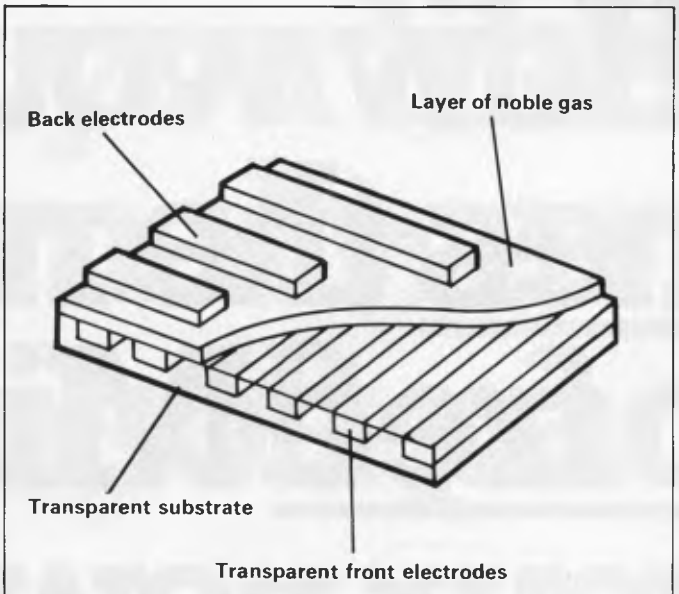

Fig 7 a *DC plasma display;*

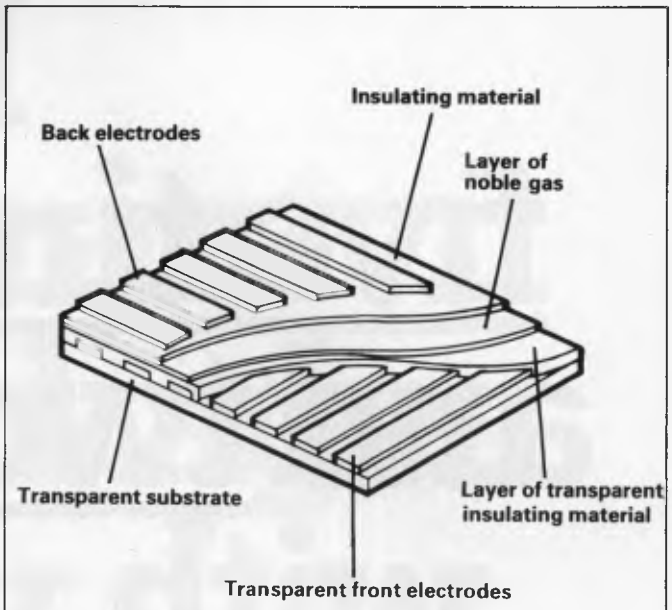

Fig 7 b *AC plasma display*

coloured pixels, only eight colours are possible, including black and white. Nevertheless, very good computer graphics displays are possible. The first display of this type is available from Seiko and it is inevitable that lapheld micros with colour display capabilities will soon be in the shops.

Not to be outdone, Epson (which is, incidentally, a subsidiary of Seiko) manufactures a colour LCD based on this filter design which uses TFTs to turn on each coloured pixel. This display is used in Epson's pocket colour TV, recently launched in the US. Unfortunately the TV isn't being introduced in Australia, but the LCD itself is soon to be available on a component basis — so, we may still see a pocket TV to Australian standards using this LCD.

Electroluminescence

Electroluminescence occurs when certain phosphorescent materials are influenced by an electric field. You may already have seen the effect used to provide a green glow in nursery night-lights. An almost identical phenomenon produces light in a light-emitting diode (LED) display.

The phosphorescent material used mostly in electroluminescent (EL) displays is zinc sulphide; a phosphor similar to those used on the screens of CRTs, but it is excited to generate light by the direct application of an electric field across it, rather than by electrons striking it. The basic EL structure, shown in Fig 6, is of a layer of zinc sulphide sandwiched by two electrodes. When a voltage is applied across the electrodes, light is produced.

According to the thickness of the zinc sulphide layer and the driving voltage, EL displays can be of four main types: direct current (DC) thick film; alternating current (AC) thick film; DC thin film; and AC thin film. Although all types have been made and demonstrated to work, it's only the AC thin film type which has been developed to the stage where reliable displays with sufficiently long life can be achieved.

The company predominant in the development of EL flat-panel displays is Sharp. Its most well known and successful EL display is used in the Grid Compass micro giving a dot matrix alphanumeric capability of 25 lines x 80 characters, and graphics.

There is significant developmental work going ahead with EL technology, and it looks plausible that it will soon be suitable for use as the basis for an alternative to the CRT as a TV display. One Japanese company has already reported an EL display made by overlaying three coloured EL thin films to produce a colour display, and Sharp has demonstrated a possible monochromatic EL display panel.

Plasma gas discharge

A number of different methods of making plasma displays exists, but all work on the principle of the breakdown of a noble gas upon application of a high voltage across electrodes. The gas breaks down into a plasma and gives off light; the most common example of which is the neon indicator, used to show the presence of mains power in many electrical appliances.

The two main varieties of plasma display differ fundamentally in the voltage applied to break down the noble gas. In the DC plasma display (Fig 7a) the electrodes are in contact with the gas, while in the AC plasma display (Fig 7b) the electrodes are close to the gas but isolated from it.

Manufacturers such as Burroughs, Fujitsu and Sony have developed plasma technology to the extent that extremely high resolution displays can be made for alphanumeric or graphics purposes. Indeed, one DC plasma display is reported to have 256,000 pixels in a 640 x 400 dot matrix format, giving on on/off resolution equivalent to standard quality CRTs.

Despite such possibilities, flat-panel plasma displays have many disadvantages which have yet to be tackled. For example, the voltages required to cause gas breakdown are high. It's a non-solid state glass envelope nature and can't possibly be as rugged as LCDs or EL displays. Furthermore, manufacturing costs are high, although modern production techniques have already shown ways of getting around this problem.

Vacuum fluorescence

Vacuum fluorescence displays (VFDs) operate in essentially the same way as

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CRTs: that is, an electron beam is fired across an electron gun to strike fluorescent material on a glass screen. Also, the whole structure is contained within an evacuated glass envelope. The main difference between CRTs and VFDs is simply the fact that the fluorescent material of a VFD is positively charged to attract the electrons within the beam. A controlling grid close to the electron gun passes or blocks the electron beam, selecting which bit of fluorescent material is struck.

You could argue from this description that VFDs should be described as flat-screen displays, rather than flat-panel, but the fluorescent screen is of a dot matrix 'panel' form in which individual dots can be accessed and illuminated.

Dot matrix VFDs of up to about 75,000 pixel dots have been manufactured but the displays are quite expensive. The potential for high-quality graphics, if not TV capability and colour displays, exists for VFDs, and the fact that the brightness of each dot may be controlled is a distinct advantage over the flat-panel displays with their on/off dot illumination.

Whether or not manufacturers see this non-solid state, vacuum-and-glass technology as being worth improving, to the point of mass production and lower cost, remains to be seen.

Conclusion

What we are about to see over the next few years is a break from the traditionally used CRT display device to the use of many other types of display. These displays will primarily be used solely in equipment built for a specific purpose: for example, lapheld portable micros, but this is only because the alternatives to the CRT are more expensive or of lower quality. Eventually, however, price will fall and quality will rise to the extent where flat-panel displays will be used in most situations where the CRT is currently exploited.

In the short term the CRT will be used at the bottom and top of the micro scale: as a TV-based display device for home or personal computers, or as a high-resolution display for graphics. During this time, flat-panel displays, as described here, will be more fully exploited as they reach their full potential.

In the long term, however, as TV displays become of non-CRT origin, the CRT will be 'kicked upstairs' to the very top-of-the-range systems, where highest resolution and detail are required. It is unlikely that new flat-panel displays will even be able to out perform CRTs in these situations, but they will soon be able to compete with TV CRTs, and they can already be compared with CRTs for graphics and alphanumeric displays.

Which are the displays of the future in the computing world? There's no doubt that LCDs are hard to beat in terms of portability and low power consumption, and for the next few years at least they will form the heart of lapheld portable micros. But, in my opinion, it will be the EL display which eventually takes over from the CRT as the main computer display device.

There's no doubt that LCDs are hard to beat in terms of portability and low power consumption, and for the next few years at least they will form the heart of lapheld portable micros.

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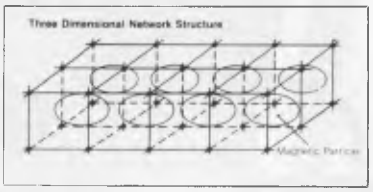

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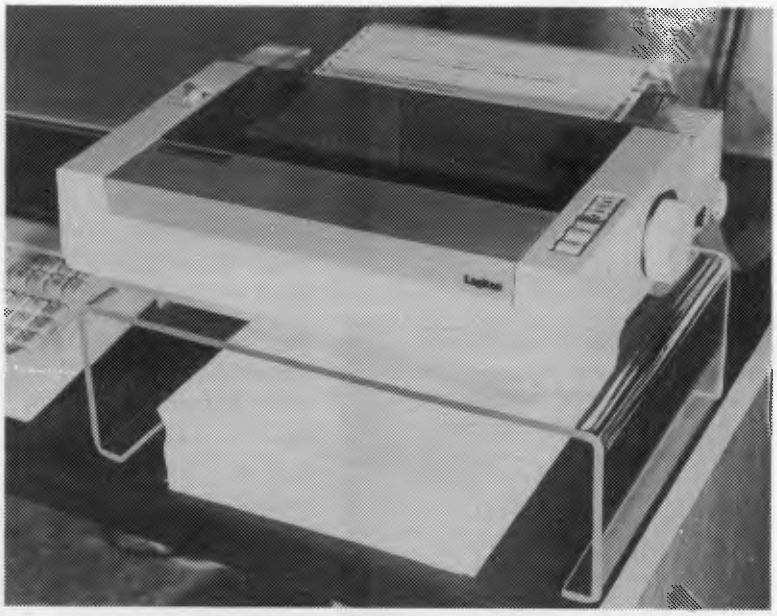

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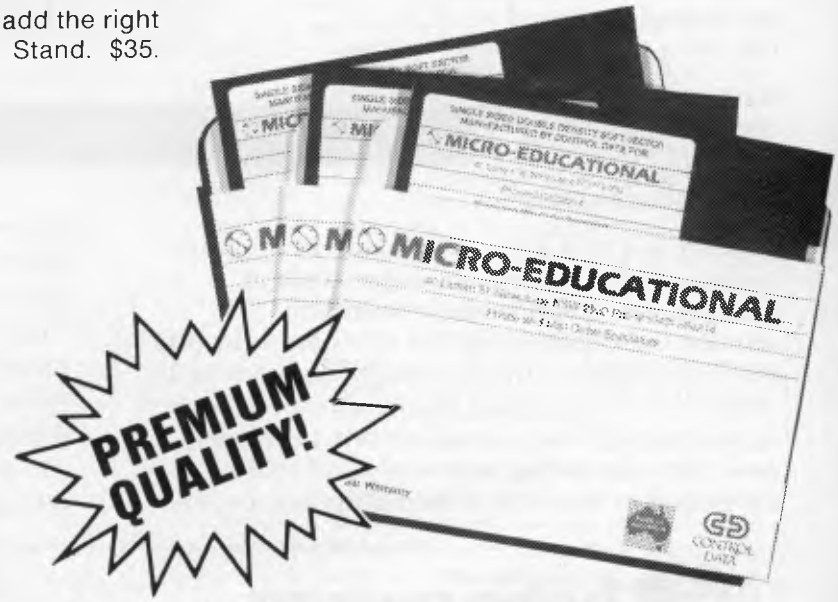

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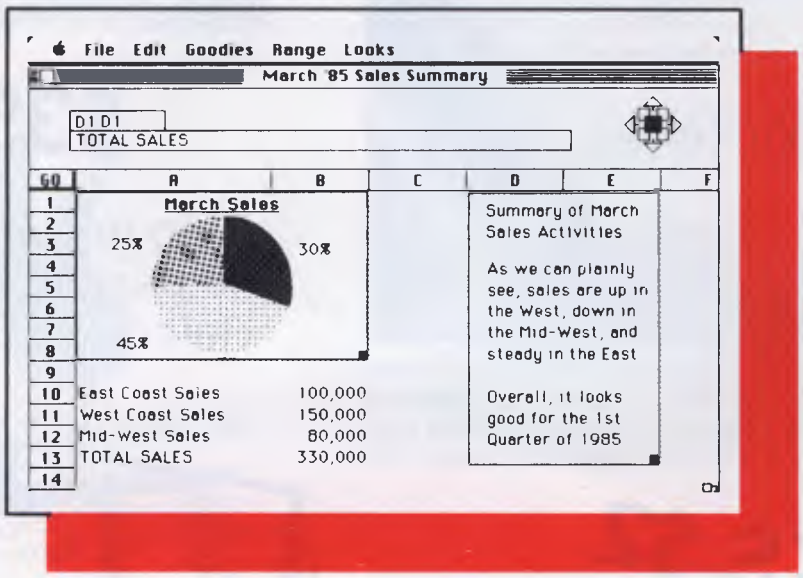

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It takes all sorts...

If you think that every important aspect of programming arises somewhere in the context of sorting and searching, then you're in full agreement with master programmer Donald Knuth. Mike Liardet looks at Sorting and Searching, the third volume of his book, "The Art of Computing Programming."

Sorting is the process of arranging things in ascending or descending order. Knuth points out that the layman's use of 'sorting' means something slightly different, and computer sorting could more correctly be called 'ordering' or 'sequencing'. In some senses sorting is related to the other topic in the volume, searching. This is because searching becomes a great deal easier once the items are sorted; imagine looking for a word in an unsorted dictionary.

Knuth divides sorting into two categories, internal and external. Internal sorting is used when all the data can be accommodated in high-speed internal memory, or RAM. External sorting is used when some, or most, of the data lies in external memory such as disks or tape, which are a great deal slower to access. This difference in access speed necessitates different approaches to the two types of sorting.

A prerequisite for external sorting is an ability to do internal sorting. However, as external sorting strategies are influenced by the hardware available and are generally more complex, I'll stick to internal sorting.

For internal sorting, Knuth presents well over two dozen different algorithms. It's not easy to pick a 'best' one, since different algorithms are better in different situations. It is, however, fairly easy to identify the worst one, called 'bubble sort'. For some perverse reason bubble sorting has enormous popularity with programmers, possible because it's easy to remember when Knuth's volume is not to hand. I'll present some of the more highly recommended routines.

A program that will enable you to test four of Knuth's sorting algorithms in a variety of different circumstances is listed in Fig 1. In all cases the data, or rather 'keys' to be sorted, are integer values in the array K (). For each key in K (), there is an associated record in the array R$(). For most sorting applications, it is not merely sufficient to sort the keys, but also the associated records: a telephone directory with the names sorted but the numbers in the original order would be quite useless! In some actual applications the keys may be an integral part of the record or they may be textual, and so on. Once you understand the algorithms it is relatively easy to tailor them to fit the specific sorting problem.

```
10000 REM INITIALIZE
10010 INPUT"NUMBER OF RECORDS TO SORT";N
10015 IF N<0 OR INT(N)<>N THEN PRINT CHR$(7):GOTO 10010
10020 INPUT"RANGE OF KEYS 1 TO..(OR 0 = IN ORDER, -1 = REVERSE ORDER)";HI
10025 IF HI<-1 OR HI>1E+08 OR INT(HI)<>HI THEN PRINT CHR$(7):GOTO 10020
10030 GOSUB 30000
10040 PRINT"SORT METHOD..."
10045 PRINT"  0. STOP"
10050 PRINT"  1. INSERTION SORT"
10060 PRINT"  2. SHELL'S SORT"
10070 PRINT"  3. QUICKSORT"
10080 PRINT"  4. DISTRIBUTION COUNTING"
10100 INPUT"ENTER 0 TO 4";CH
10105 IF CH<0 OR CH>4 OR INT(CH)<>CH THEN PRINT CHR$(7):GOTO 10100
10107 IF CH=0 THEN STOP
10110 ON CH GOSUB 20000,21000,22000,23000
10115 PRINT CHR$(7);CHR$(7);CHR$(7);
10120 GOSUB 31000
10130 RUN
20000 REM INSERTION SORTING - N ITEMS IN K() AND R$()
20010 FOR J=2 TO N
20020 K=K(J):R$=R$(J)
20030 FOR I=J-1 TO 1 STEP -1
20040 IF K>=K(I) THEN 20080
20050 K(I+1)=K(I):R$(I+1)=R$(I)
20060 NEXT I
20070 I=0
20080 K(I+1)=K:R$(I+1)=R$
20090 NEXT J
20100 RETURN
21000 REM SHELL'S SORT
21010 DIM H(15)
21020 H(1)=1
21030 FOR I=2 TO 15
21040 H(I)=3*H(I-1)+1:IF H(I)>=N THEN 21070
21050 NEXT I
21060 PRINT"N>7174453 ERROR":STOP
21070 T=I-2:IF T<1 THEN T=1
21080 FOR S=T TO 1 STEP -1
21090 H=H(S)
21100 FOR J=H+1 TO N
21110 K=K(J):R$=R$(J)
21120 FOR I=J-H TO 1 STEP -H
21130 IF K>=K(I) THEN 21170
21140 K(I+H)=K(I):R$(I+H)=R$(I)
21150 NEXT I
21160 REM ASSUMES I IS DEFINED ON COMPLETION OF FOR-LOOP
21170 K(I+H)=K:R$(I+H)=R$
21180 NEXT J
21190 NEXT S
```

```
21200 RETURN
22000 REM QUICKSORT WITH INSERTION SORTS FOR M OR LESS ITEMS
22010 DIM LSTACK(20),RSTACK(20)
22015 INPUT "M VALUE (EG 9):";M
22020 IF N<=M THEN 22150
22030 TOP=0:LFT=1:RGHT=N:K(0)=-1E+10:K(N+1)=1E+10:REM !!!GOTO 22040
22031 LFT=0:RGHT=N+1
22032 SWAP K(INT((LFT+RGHT)/2)),K(LFT+1):SWAP R$(INT((LFT+RGHT)/2)),R$(LFT+1)
22034 IF K(LFT)>K(LFT+1)THEN SWAP K(LFT),K(LFT+1):SWAP R$(LFT),R$(LFT+1)
22036 IF K(LFT+1)>K(RGHT)THEN SWAP K(LFT+1),K(RGHT):SWAP R$(LFT+1),R$(RGHT)
22038 IF K(LFT)>K(LFT+1)THEN SWAP K(LFT),K(LFT+1):SWAP R$(LFT),R$(LFT+1)
22039 LFT=LFT+1:RGHT=RGHT-1
22040 K=K(LFT):R$=R$(LFT)


22050 I=LFT:J=RGHT+I
22060 I=I+1:IF K(I)<K THEN 22060
22070 J=J-1:IF K<K(J) THEN 22070
22080 IF J>I THEN SWAP K(I),K(J):SWAP R$(I),R$(J):GOTO 22060
22090 SWAP K(LFT),K(J):SWAP R$(LFT),R$(J)
22100 IF RGHT-J>=J-LFT AND J-LFT>M THEN TOP=TOP+1:LSTACK(TOP)=J+1:RSTACK(TOP)=RGHT:RGHT=J-1:GOTO 22040
22110 IF J-LFT>RGHT-J AND RGHT-J>M THEN TOP=TOP+1:LSTACK(TOP)=LFT:RSTACK(TOP)=J-1:LFT=J+1:GOTO 22040
22120 IF RGHT-J>M AND M>=J-LFT THEN LFT=J+1:GOTO 22040
22130 IF J-LFT>M AND M>=RGHT-J THEN RGHT=J-1:GOTO 22040
22140 IF TOP>0 THEN LFT=LSTACK(TOP):RGHT=RSTACK(TOP):TOP=TOP-1:GOTO 22040
22150 IF M>1 THEN GOSUB 20000
22160 RETURN
23000 REM DISTRIBUTION COUNTING
23010 IF HI>1000 THEN PRINT CHR$(7);"KEY RANGE > 1000!!":RUN
23020 U=1:V=HI
23030 DIM COUNT(V-U)
23040 FOR I=0 TO V-U:COUNT(I)=0:NEXT I
23050 FOR J=1 TO N:COUNT(K(J)-U)=COUNT(K(J)-U)+1:NEXT J
23060 FOR I=1 TO V-U:COUNT(I)=COUNT(I)+COUNT(I-1):NEXT I
23065 R=N


23070 IF R=0 THEN RETURN
23080 IF COUNT(K(R)-U)<R THEN R=R-1:GOTO 23070
23090 IF COUNT(K(R)-U)=R THEN COUNT(K(R)-U)=COUNT(K(R)-U)-1:R=R-1:GOTO 23070
23100 R$=R$(R):K=K(R):J=COUNT(K(R)-U):COUNT(K(R)-U)=COUNT(K(R)-U)-1
23110 S$=R$(J):S=K(J):L=COUNT(K(J)-U):COUNT(K(J)-U)=L-1:R$(J)=R$:K(J)=K:R$=S$:K=S:J=L:IF J<>R THEN 23110
23120 R$(J)=R$:K(J)=K:R=R-1:GOTO 23070
30000 REM SET UP K() AND R$() WITH N VALUES DETERMINED BY HI
30010 DIM K(N+1),R$(N)
30020 FOR I=1 TO N
30030 IF HI>0 THEN K(I)=INT(RND(1)*HI+1)
30040 IF HI=0 THEN K(I)=I
30050 IF HI=-1 THEN K(I)=N-I+1
30060 R$(I)=STR$(K(I))
30070 NEXT I
30080 IF HI<=0 THEN HI=N


30090 RETURN
31000 REM CHECK K() IS SORTED AND R$() IS IN STEP WITH IT
31010 FOR I=1 TO N
31020 PRINT I,K(I)
31030 IF K(I)<>VAL(R$(I)) THEN PRINT"^^RECORD ERROR^^"
31040 IF I=1 THEN 31060
31050 IF K(I)<K(I-1) THEN PRINT"^^ORDER ERROR^^"
31060 NEXT I
31070 RETURN
```

Fig 1 Sorting program

Line 10000 — Initialisation and menu control
Line 20000 — Insertion sorting routine
Line 21000 — Shell's sorting routine
Line 22000 — Quicksort routine
Line 23000 — Distribution counting routine
Line 30000 — Routine to initialise data to be sorted
Line 31000 — Routine to print and check sorted data

Fig 2 Sorting program structure

The program is structured as shown in Fig 2.

The simplest sorting algorithm is called 'insertion sorting'. Imagine a situation where the list of keys is partitioned in two, with a sequence of keys in order up to a given point, and thereafter out of order. For example:

2 3 5 6 4 8 9 7 1

By scanning the values to the left of the marked key, we can gradually move these values one place right until we arrive at the right place to insert the marked key. This increases the size of the sorted partition by one. The above example would become:

2 3 4 5 6 8 9 7 1

By repeatedly applying this method, the sorted partition grows until all the keys are sorted. To get it started, only the first key is deemed to be sorted since any single value must be 'sorted', no matter what it is. Initially all keys, bar the first, are in the unsorted partition. In the Basic routine (Fig 1, line 20000) the variable J marks the boundary between the two partitions, and K is used to hold the key to be inserted — it cannot be left *in situ*, as it would be overwritten by the shuffling up to accommodate it.

Shell sorting was devised by Donald L Shell in 1959. In some sorting algorithms, the keys are only moved short distances at a time; this can be highly inefficient if the keys have to move a long way. Shell's method 'encourages' the keys to move in long jumps initially, and it then works out the details later by successively shorter jumps, or 'increments'. If the increments are successively 4, 2 and 1, the following nine keys would be sorted as follows:

```
        5 7 9 4 3 1 2 6 8
        *       *       *
4-sort.
        3 1 2 4 5 7 9 6 8
        *   *   *   *   *
2-sort.
        2 1 3 4 5 6 8 7 9
        * * * * * * * * *
1-sort.
        1 2 3 4 5 6 7 8 9
```

In effect the 4-sort does an insertion sort on four independent sequences of keys, where in each sequence the keys are four apart. The first of these sequences (marked with asterisks) comprises the keys 5, 3 and 8. The second comprises the keys 7 and 1, and so on. Note that all four of these sequences are correctly sorted following the 4-sort. The 2-sort does the same thing for just two sequences, with keys two apart. Finally, the 1-sort sorts a single sequence of adjacent keys and gets everything in the right order. In fact, the 1-sort is identical to the insertion sort.

Any sequence ending with 1 will work. (Insertion sorting is a special case of the method with a single increment of 1 being used.) In fact powers of 2 provide a fairly

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Shell	1:55	1:26	1:03	1.35	1.5
Quicksort (M=9)	1:01	0:50	$$$$	$$$$	1.5
Quicksort (M=1)	1:03	0:58	$$$$	$$$$	1.5
Quicksort + (M=9)	1:00	0:51	7:30	7:04	1.5
Quicksort + (M=1)	1:02	0:59	7:18	6:52	1.5
Distr. Counting	0:34	0:27	0:26	0:34	1.5

Fig 3 Performance of the sort routines

```
35000 REM BINARY SEARCH FOR K IN N KEYS IN K(), RETURNS POSN (=-1 FOR FAILURE)
35010 L=1:U=N
35020 IF U<L THEN POSN =-1:RETURN
35030 POSN=INT((L+U)/2)
35040 IF K<K(POSN)THEN U=POSN-1:GOTO 35020
35050 IF K>K(POSN)THEN L=POSN+1:GOTO 35020
35060 RETURN
```

Fig 4 Binary search routine

poor performance, and after extensive analysis Knuth suggests some better alternatives. One of these is the sequence used in the routine here (Fig 1, line 21000). The increments are produced from the expression $(3^K - 1)/2$, with values of K decreasing from some initial value down to 0. (The code given does calculate these values but without recourse to exponentiation, and the increments are held in the array H().) The initial value used is the largest possible, not exceeding one third of the number of items to be sorted. For example, to sort 1000 keys the increments would be 121, 40, 13, 4 and 1.

Quicksort

The Quicksort method was devised by C A R Hoare in 1962. This is one of the more complex methods to code (Fig 1, line 22000) particularly if the implementation language is not recursive — as is the case with Basic. In its basic form, a list of keys is sorted by choosing the first key as a 'pivot' and then dividing the remaining keys into two partitions: keys to the left being less than, or equal to, the pivot; and to the right being greater than, or equal to, the pivot. To obtain these two partitions we scan right from the first key after the pivot until we find a 'rogue' key (greater than the pivot) and scan left from the end until we find another rogue key (less than the pivot). These keys can then be swapped, and this continues until the right scan crosses the left; this is the correct position for the pivot element. For example, quicksorting the following numbers:

5 7 9 4 3 1 2 6 8

Exchange 7 and 2.

5 2 9 4 3 1 7 6 8

Exchange 9 and 1.

5 2 1 4 3 9 7 6 8

Place pivot (exchange 5 and 3) . .

3 2 1 4 5 9 7 6 8

At this point the 5 is correctly placed; all the values to the left of it are less than it, and all those to the right are greater. Sorting these two partitions can be seen as two separate independent problems, so we can continue by quicksorting 3, 2, 1 and 4, and then quicksorting 9, 7, 6 and 8, and so on.

There are various refinements to this method. As insertion sorting is generally regarded as the most efficient method for small lists, we can invoke insertion sorting instead of quicksorting when the lists get below a particular size (the value M in Fig 1 at line 22000). There's nothing to lose by abandoning the sorting when a list gets below size M, and then calling insertion sorting just once for the whole list, right at the end. Note that if M is 1, then pure quicksorting is used.

A major problem with quicksorting is that it's at its worst when the list is already sorted. Unlike most methods, it's at its best when the keys are scrambled. This seems very unsatisfactory, and can be corrected to some degree by arranging for a more careful choice of pivot. The method recommended by Knuth is to first interchange the second and middle keys in the list, then sort just the first, second and last keys, pivoting on the middle one. For the aforementioned sequence:

5 7 9 4 3 1 2 6 8

Swap the second and middle. .

5 3 9 4 7 1 2 6 8

Sort first, second and last only. .

3 5 9 4 7 1 2 6 8

Now partition the third to last keys using 5 as the pivot. .

3 5 2 4 1 7 9 6 8

Insert pivot in the right position. .

3 1 2 4 5 7 9 6 8

This procedure makes little difference to randomly ordered keys, and considerably improves the situation if the keys are already ordered.

Both these enhancements are incorporated in the routine at line 22000. The routine prompts for a suitable value of M before starting: Knuth recommends 9 as optimum, although the best value depends on the characteristics of the programming language you are using. Lines 22031 to 22039 make a careful selection of the pivot. Simple pivot selection is obtained by deleting the REM at line 22030.

In circumstances where the keys are numeric and have a restricted range of values, a very efficient sorting procedure can be applied by noting the frequency of occurrence of each key. This is the strategy adopted by 'distribution counting' sorting. The first phase of the algorithm obtains the number of occurrences for each key. In Fig 1 at 23000, if the lowest key value is U and the highest is V, then COUNT (0) holds the number of occurrences of U, and COUNT (V-U) holds the number of occurrences of V. For example, the counts for the 2 3 1 1 3 2 1 2 2 would be:

1-count: 3
2-count: 4
3-count: 2

Once sorted, we will see 3 '1's followed by 4 '2's, followed by 2 '3's. If each of the counts is now accumulated, for example, the 2-count becomes 3+4 and the 3-count becomes 3+4+2, then the value in each count will indicate the last position for each of the corresponding keys:

1-count: 3
2-count: 7
3-count: 9

So the '1's will appear in position 1 to 3, the '2's in 4 to 7, and the '3's in 8 to 9.

Now, scanning the numbers from right to left, we search for a key which is too far to the left:

```
        *
2 3 1 1 3 2 1 2 2
```

The totals in the counts make this test relatively easy, and the found key can be inserted at the position indicated by its count (position 9):

2 3 1 1 2 1 2 2 3

By adjusting the counts and repeating this process, it is then possible to get all the keys into the correct order. Fig 1 (at line 23000) contains extra sophistications which further minimise the amount of scanning and moving needed to sort the keys.

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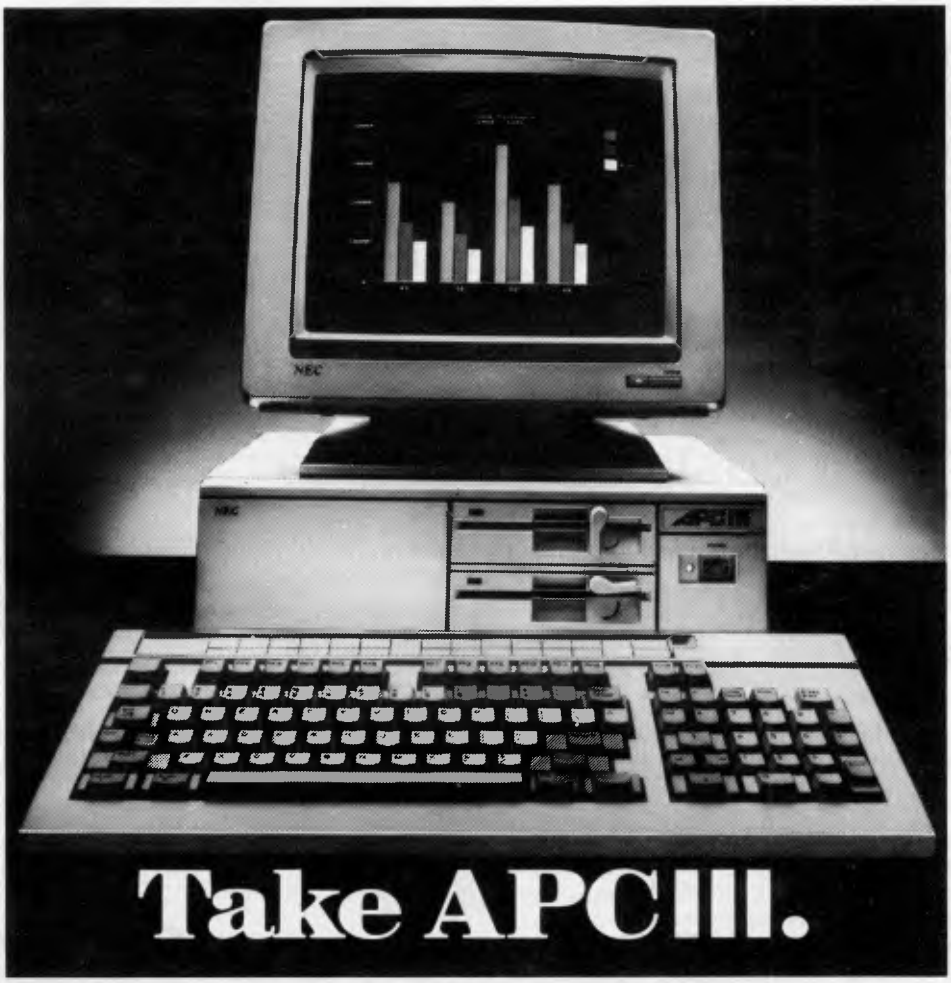

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In order to assess how effective these different algorithms are, Fig 3 outlines the results of running each of them under various conditions. The times are in minutes and seconds (obtained in interpreted Microsoft Basic on an Apricot — some appreciation of the performances can be gained by noting that it takes all of 12 seconds just to initialise the data for 500 keys). $ signs indicate times definitely in excess of 10 minutes and estimated to be about one hour, demonstrating the appalling behaviour of standard Quicksort if the keys are ordered. The following conclusions can be drawn.

Insertion sorting is good for short-lists but hopeless for long ones, unless the list is already, or very nearly, in order. (All methods appear equal for short lists in Fig 3, but this is due to inadequacies in my reflexes.) This is the only method considered here that maintains equal keys in their original order — this can be important for some applications.

Shell sorting performed well on all tests, with consistent response times no matter what the state of the input.

Quicksorting is excellent for random lists, but no use for ordered lists. Pure quicksorting (when M=1) is slightly slower than quicksort combined with insertion sorting. More careful selection of a pivot value mitigates the ordered list problem.

Distribution counting was best all round, but is not universally applicable.

If asked to nominate a good, general-purpose, workhorse sort routine I would choose Shell sorting. In fact it would not be difficult to write a super-sort procedure which, from a preliminary scan of the data, could choose the most appropriate routine. Knuth covers another 20 or so possible algorithms.

Searching

Of the two topics, Knuth gives far more prominence and material to sorting. Searching is concerned with retrieving data that has been stored with a given identification. The identification is the 'key', and the data is the associated 'record'.

Sequential searching is the most obvious technique for searching a list: start at the front, and keep going until either you find the key you want or reach the end. On average half the keys are scanned for a successful search, and all of them are scanned for an unsuccessful one.

A more efficient technique, which is almost as simple to implement, is called binary search (Fig 4); this only works if the list is in order. Given an ordered list of keys, examine the middle one, which will either be greater, less, or equal to the key we are seeking.

If it's equal then we have successfully found the key. If it's less than the given key, then we can continue searching for the key in the right half of the list, otherwise continue on the left. The search terminates unsuccessfully when there is no list left, when lower pointer L exceeds pointer U in the routine given.

As it's a more efficient technique, binary search can be blindingly fast even for very long lists. A maximum of 20 comparisons would be made to search a million keys — quite an improvement on straight sequential search. Marginal improvements have been suggested — not examining the middle element every time, but making a more careful choice determined by the key we are seeking. In practice, the increase in complexity offsets any other gains.

Binary trees

Frequently, following an unsuccessful search, we may wish to insert the unfound key. If we are using binary search, then this can be computationally expensive for long lists of keys. If, instead of storing the keys sequentially, a 'binary tree' structure can be used, then binary search and easy insertion can coexist (Fig 5). The price for this is that the tree requires slightly more storage and is more complex to scan.

A binary tree is built up of 'nodes'. Each node contains the text of one key, and

```
50000 REM BUILDS AND SEARCHES A BINARY TREE
50010 DIM KEY$(1000),BEFORE(1000),AFTER(1000)
50020 KEY$(1)="ROOT":BEFORE(1)=0:AFTER(1)=0
50030 AVAIL=2
50040 INPUT"TYPE A KEY";KEY$
50050 GOSUB 51000:IF FOUND=1 THEN PRINT"ITS AT NODE ";NODE:GOTO 50040
50060 PRINT"NOT FOUND - INSERTING IT"
50070 GOSUB 52000
50080 PRINT"AND ITS AT NODE ";NNODE:GOTO 50040
51000 REM SEARCH BINARY TREE SETS FOUND AND NODE
51010 NODE=1:REM START AT ROOT
51020 IF KEY$=KEY$(NODE)THEN FOUND=1:RETURN
51030 IF KEY$<KEY$(NODE) AND BEFORE(NODE)<>0 THEN NODE=BEFORE(NODE):GOTO 51020
51040 IF KEY$>KEY$(NODE) AND AFTER(NODE)<>0 THEN NODE=AFTER(NDDE):GOTO 51020
51050 FOUND=0:REM FAILURE (BUT NODE SET FOR INSERTION)
51060 RETURN
52000 REM (FOLLOWING UNSUCCESSFUL SEARCH) CREATE AND INSERT A NODE FOR KEY$ BEFORE/AFTER NODE
52010 IF AVAIL>1000 THEN PRINT"STORAGE OVERFLOW!":STOP
52020 KEY$(AVAIL)=KEY$:BEFORE(AVAIL)=0:AFTER(AVAIL)=0:NNODE=AVAIL:AVAIL=AVAIL+1
52030 IF KEY$<KEY$(NODE)THEN BEFORE(NODE)=NNODE:RETURN
52040 AFTER(NODE)=NNODE:RETURN
```

Fig 5 Binary tree program

```
40000 REM SOUNDEX FOR ANY X$ <>"" AND CONTAINING ONLY "A" TO "Z"
40010 DATA "AEHIOUWY","BFPV","CGJKQSXZ","DT","L","MN","R"
40020 DIM GROUP$(6):FOR I=0 TO 6:READ GROUP$(I):NEXT I
40030 REM GROUP$(0) IGNORED, OTHERWISE A LETTER IN GROUP$(I) HAS DIGIT I
40040 SNDEX$=LEFT$(X$,1):REM FIRST LETTERS OF SOUNDEX AND X$ ARE THE SAME
40050 C$=SNDEX$:GOSUB 41000:OVAL$=VALU$
40060 FOR I=2 TO LEN(X$)
40070 C$=MID$(X$,I,1):GOSUB 41000
40080 IF VALU$="0" OR VALU$=OVAL$ THEN 40100:REM SKIP "VOWELS" AND "REPETITIONS"
40090 SNDEX$=SNDEX$+VALU$
40100 OVAL$=VALU$
40110 NEXT I
40120 SNDEX$=LEFT$(SNDEX$+"000",4):REM TRUNCATE/PAD WITH TRAILING 0S
40130 RETURN
41000 REM RETURN VAL$ FOR GIVEN C$ + CHECK FOR ILLEGAL LETTERS
41010 FOR VALU=0 TO 6
41020 CHS$=GROUP$(VALU)
41030 FOR J=1 TO LEN(CHS$)
41040 IF C$=MID$(CHS$,J,1)THEN VALU$=CHR$(ASC("0")+VALU):RETURN
41050 NEXT J
41060 NEXT VALU
41070 PRINT"ILLEGAL LETTER: ";C$:STOP
```

Fig 6 Soundex routine

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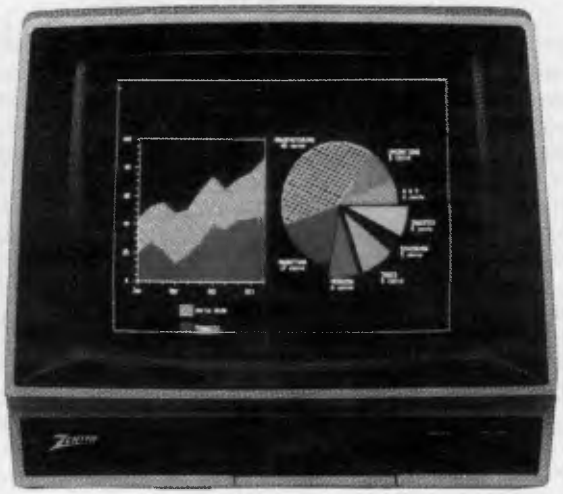

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pointers to the before and after nodes. (In real applications there may be other information as well.) These pointers reference other nodes from which all the words before or after the current node can be accessed, if there are no other nodes, the pointers are simply 'null'.

A binary tree is searched, starting at the root node. If this node contains the key then we have found the place we want. Otherwise the key must be before or after the current node, and we move to the next node accordingly and repeat the process.

If there is no next node then the key is not in the tree, and we can insert it at this point if necessary.

This method works best with storage management routines to allocate and de-allocate storage as nodes (that is, keys) are added and deleted. In the routine given here only minimal storage management is attempted to keep things simple.

In some cases a binary tree can become unbalanced. The worst case occurs if the keys are inserted in order, when the algorithm just performs an unnecessarily complex sequential search. If the keys are presented in a suitably random order, then all the branches will be at roughly the same depth. Knuth also presents techniques for keeping trees well balanced.

Throughout this analysis we have assumed that it is readily possible to identify two keys as being equal. But when working on an interactive system, it can sometimes be a problem to recall the precise spelling of a word, such as a surname. Knuth presents a technique, called soundexing, which can convert similar sounding words into the same key (Fig 6). The technique was developed by Margaret Odell in 1918, predating computers by a good many years. Essentially the method converts any word into a key, consisting of a letter followed by three digits. Similar sounding letters are assigned the same digit; vowels and a few other letters are ignored altogether, as are repeated letters.

Conclusion

This concludes my presentation of Knuth's three volumes on *The Art of Computer Programming*. It should be remembered that these volumes run to over two thousand pages in total, so I have had to be highly selective as to which material I have featured.

Unfortunately many interesting and pertinent algorithms have fallen by the wayside, and if my writings have whetted your appetite for more information then you will have to buy the volumes to find out more.

References

The Art of Computer Programming, by Donald E Knuth; Addison-Wesley Publishing Company.
Volume 1 Fundamental Algorithms
Volume 2 Seminumerical Algorithms
Volume 3 Sorting and Searching

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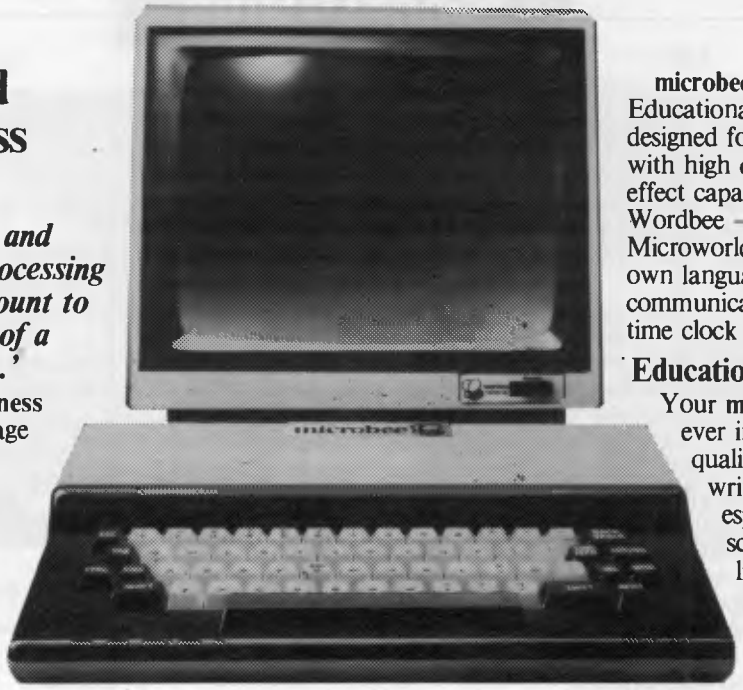

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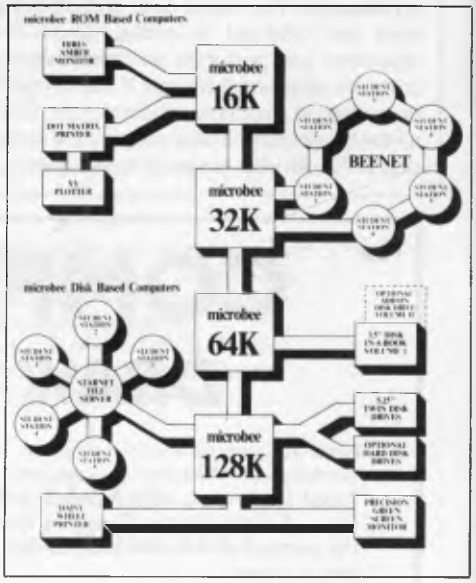

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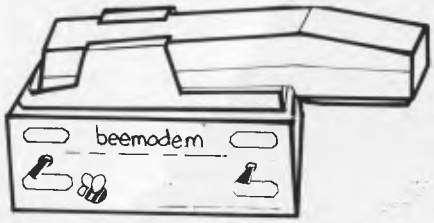

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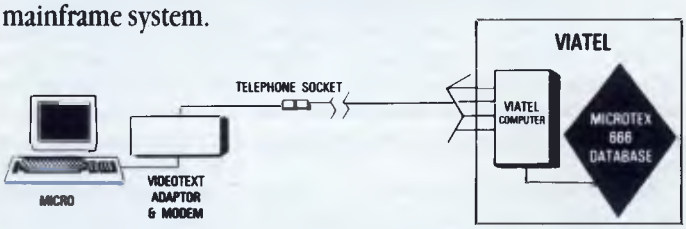

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BANKS' STATEMENT

Eastern rising

All is not quiet on the Japanese front — MSX is stirring. Martin Banks takes cover and observes.

Ever since 1980 there has been a whole boat-load of pundits around, confidently predicting the imminent arrival of the Japanese on the personal computing scene. 'Watch out', the pundits all cried, 'the Japanese are coming and they are going to wipe everyone else off the face of the earth.'

The logic behind this suggestion was quite sound, based on the idea that personal computers, of the home/game-playing variety especially, were high-volume, low-value devices of a domestic nature. This made them the ideal product family for the Japanese to adopt.

That, at least, was the theory. In practice, it didn't work out that way. The Japanese focused most of their attention on the Apple-equivalent market and above, looking to break into the lucrative small business machine area. This required not only good hardware, which they often managed to produce, but good software too. This they failed to come up with. Their operating systems were poor, for one reason or another. It was said, for example, that the OS for the Sharp 3201 machine was truly excellent except for one thing — it was dreadfully slow. It was a full 'belt and braces' system that never got it wrong, it just took forever to do it.

The Japanese missed out on the small business market, which went first to Commodore, Tandy and Apple, and subsequently to IBM *et al*, and missed the boat on the home computer boom, which went to to the likes of Commodore.

Now the Japanese are having a concerted pitch at the home market again with the MSX machines jointly developed by Microsoft and a whole bunch of Japanese companies. These have generally been well received by reviewers, who have been impressed with the machines but less impressed with the price, considering what you get — essentially an old-fashioned 8-bit machine that the likes of Sinclair has left far behind.

The MSX family does have one thing going for it already, and has some interesting possibilities for the future. Its present advantage is standardisation. There are a whole range of machines coming from different manufacturers that can all use the same software, up to a point. This means that the software authors get a large potential market and become interested in writing for it, which in turn means that the users get programs to play with, plus a choice of machines.

Another advantage of the MSX family is its lineage, which comes from roots buried deep in the dear old CP/M operating system. This means that an MSX system, coupled to a disk drive or two, can become a CP/M machine. Not terribly startling, but the home market is starting to drift upwards in terms of capabilities. People now want to do more than just play 'nuke-the-world' games, and that means two things: bigger systems and better software. It also means that the software has to be available, and that's where CP/M comes in: there's a lot of good, low(ish)-cost applications software waiting to be picked up.

This leads the current MSX machines into a number of alternative routes for the future, stretching from home applications through to real business.

At the home end, it's certain that you will see the machines being applied more and more in association with other systems and equipment. One reason for this is that Japanese manufacturers are now working hard to get the production costs of an MSX machine down to the absolute minimum. The latest versions are said to consist of just seven circuits, which means it will be cheaper to make and smaller to integrate into other things. Yamaha has already pointed the way with its new computer/organ and there will be plenty of other combination products of this type in the future, especially in the area of interactive video.

Most of these applications will be ideal for the 8-bit Z80 processor used in MSX for several years to come, and the standardisation of the technology and software will make it increasingly easy for manufacturers to 'bury' such a computer in their products. But the MSX family is unlikely to stop there.

An important aspect of the standard is its file structure when working with disk drives. These are directly compatible with the existing Microsoft industry standard for 16-bit personal computers, the MS-DOS operating system. Although it won't run an MS-DOS program, MSX will read data files written under MS-DOS and *vice versa*.

This compatibility is important for the future of the standard, for Microsoft and the Japanese companies have designs upon a certain market-place. That market-place is the one that will be effectively vacated by IBM as it moves its Personal Computer family upwards technologically, and in performance.

Microsoft founder, Bill Gates, talks quite openly about MSX growing into a 16-bit system at some time. There is little doubt that, from the hardware point of view, it could be done already. The standard is already part way to being MS-DOS, and MS-DOS runs on the 8088/8086 family of processors. An MSX machine based on one of these would not be difficult to engineer.

What is important, therefore, is the market timing. IBM is the key here, for this year will see it move its products inexorably upwards. There is already the PC/AT, which is based on the Intel 80286 chip, and there are strong hints of a replacement for the PC itself in the near future. This could well be based on the 286 chip's close relative, the 80186 processor. Although the company is also expected to introduce a lap-held machine this year, which will probably be based around the new low-power CMOS versions of the 8088 chip, such moves would leave a chink of light in the original PC market which would mark the first openings of a window of opportunity for the MSX range.

As the IBM PC family gets more powerful (though still compatible) it will leave a hole at the bottom of the market. This will be at a time when a new breed of users, the small professional individual and the more advanced domestic user, will want the power and performance of the PC without the expense. For performance it is, of course, important to read the words 'working applications software', and that is just what the MS-DOS environment will offer — a wealth of proven applications software. With its existing compatibility and the upward move towards 16-bit processing, this type of machine can be expected.

picture, simply CALL 768. From machine language do a JSR 300 and from the monitor type 300G.

The program contains two parameters which allow you to choose whether you want to inverse hi-res page 1 page 2 or both. There are screen switches which allow you to bring either hi-res pages on the screen without erasing the picture (like the HGR and HGR2 commands, but without clearing the screen) so you can see the picture that is already in memory and inverse if you want. Also there are switches which give you full screen graphics or mixed text and graphics. These switches are software controllable and are built into the Apple.

Addresses of parameters

777 ($309) — This byte contains the most significant byte of the starting address to be inversed. This should be set to 32($20) for inversing page 1 and 64($40) for inversing page 2. Default=32($20).
826 ($33A) — This byte contains the most significant byte (MSB) of the end address to be inversed. This should be set to 64($40) for inversing page 1 and 96($60) for inversing page 2. Default=64($40).

To inverse both hi-res pages, the MSB of the starting address must be set to 32($20) which is the start of hi-res page 1, and the end address must be set to 96($60) which is the end of page 2.

To set these parameters in a machine language program issue a STA, STX, or STY command to the appropriate address ($309 or $33a hex) with the correct hexidecimal value.

Screen switches

To switch to page 1 type
POKE-16297,0:POKE-16300,0:POKE-16304,0
To switch to page 2 type
POKE-16297,0:POKE-16299,0:POKE-16304,0
To get full screen graphics after switching to either page type POKE-16302,0
To get mixed text and graphics after switching, type POKE-16301,0

A Lim

```
300:A0 00 8C 11 03 8C 16 03
308:A0 20 8C 12 03 8C 17 03
310:AD 00 20 49 7F 8D 00 20
318:EE 11 03 EE 16 03 AC 11
320:03 C0 FF F0 03 4C 10 03
328:A0 00 8C 11 03 8C 16 03
330:EE 12 03 EE 17 03 AC 12
338:03 C0 40 F0 03 4C 10 03
340:60
```

Listing 1

```
10 FOR X=768 TO 832:READ D:POKE X,D:NEXT:END
20 DATA 160,0,140,17,3,140,22,3,160,32,140,18,3,140,23,3,173,0,32,73,127,
        141,0,32,238,17,3,238,22,3,172,17,3,192,255,240,3,76,16,3,160,0,140,
        17,3,140,22,3,238,18,3,238,23,3,172,18,3,192,64,240,3,76,16,3,96
```

Listing 2

VARIABLE VZ GOTO

The following routine eliminates those massive if then lists like:

IFA=10THEN100
IFA=20THEN110
IFA=30THEN120
etc.

After calling the routine, the variable 'GT' holds the value of the line to GOTO

To use, simply compute your line number to GOTO (or GOSUB) and having computed GT simply GOTO or GOSUB 2

F Olsen

```
0 GOTO1000
1 GOTO XXXX:' MUST LEAVE SPACE AND DO NOT ALTER FIRST TWO LINES
2 T$=STR$(GT)
3 T=LEN(T$):IFT<6THENT$=T$+CHR$(32)+T$:GOTO3
4 FORC=2TO6:POKE31478+C,ASC(MID$(T$,C,1)):NEXT:GOTO1
```

TI-99/4A GRAPHICS

The following instructions describe how to 'confuse' the TI's video chip, the TMS 9918A. The result looks like a computerised version of the climax of 2001: A Space Odyssey.

1 Type a REM statement into line 10, followed by as many Control 0s as you can fit on the line. Unless this character has been previously defined the line will appear empty. After you have done this press ENTER.

2 Edit this line by typing 10 followed by Function E. The line will be listed containing a large number of the word UNBREAK. Soon the top of the line will scroll off the top of the screen, and the cursor will disappear with it.

3 Now type Function S (back arrow) a few times. The screen will turn white, and the writing will scroll to the side.

4 Do not press ENTER! Instead press any other key (except Function E or Function X). The best keys to press are Function S and Function D, but other keys will work as well. Soon multicoloured patterns will appear, changing as you press keys. Occasionally the screen will be distorted by spectacular multicoloured displays.

5 If you press ENTER you will return to Basic. However the screen will probably have changed colour, and any Basic program in memory will be distorted.

J Smart

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There's Easi-Amsword — a superb word processing programme. You can create all manner of letters and documents, edit, file and retrieve. You can output in 40 column or 80 column displays and there are various options for overtyping, print formatting, etc. And Amstrad utilises the industry standard Centronics compatible parallel printer port.

You'll find Easi-Amscalc to be ideal for spreadsheet analyses. It also includes a linked bar chart graphics option. Very simple to use and understand, yet capable of producing complex balance sheets, cash flow analyses, project costings and so on.

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There's plenty for the advanced user too.

The Amstrad CPC464 is supplied with 64K RAM as standard, over 42K of which is actually available to the user. Thanks to the implementation of ROM overlay techniques, this substantial usable RAM gives an indication of the sophistication and complexities in programming that are possible.

There's much more than we can go into here, but think what you can do with CP/M* or BASIC, a graphics capability of three screen handling modes, a palette of 27 colours and resolution up to 640 x 200 pixels.

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This whole magazine is not big enough to tell you everything there is to say about this exciting new computer and its business applications. What's more, we haven't even mentioned the wonderful games, home and educational uses for the Amstrad CPC464. You can see it demonstrated and find out all the information you need to know from leading department stores and computer retailers around Australia.
Make a point of seeing the new Amstrad CPC464 without delay.

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TPB/368

PRETTY PC PICS

This program draws seven mathematically based graphs which have been converted from an old text-based Basic to the graphics of the IBM PC. This program requires the color graphics adapter to work.

M Hindson

```
1  SCREEN 1,1:W=7:CLS:KEY OFF
2 FOR COUNT=1 TO W:ON COUNT GOSUB 12,13,14,15,16,17,18
3 FOR X=-30 TO 30 STEP 1.5
4 C=0
5 Y1=5*INT(SQR(900-X^2)/5)
6 FOR Y=Y1 TO -Y1 STEP -5
7 Z=INT(25+FNA(SQR(X^2+Y^2))-.7*Y)+50
8 IF Z<=C THEN 10
9 C=X:PSET (Z*2,(X+50)*2)
10 NEXT Y,X
11 LOCATE 20,27:PRINT"Pattern No.";COUNT:O$=INPUT$(1):CLS:NEXT:END
12 DEF FNA(Z)=30*(COS(Z/16))^2:RETURN
13 DEF FNA(Z)=30*EXP(-Z*Z/100):RETURN
14 DEF FNA(Z)=SQR(900.01-Z*Z)*.9-2:RETURN
15 DEF FNA(Z)=30-30*SIN(Z/18):RETURN
16 DEF FNA(Z)=30*EXP(-COS(Z/16))-30:RETURN
17 DEF FNA(Z)=30*SIN(Z/10):RETURN
18 DEF FNA(Z)=EXP(COS(Z/4.8)*COS(Z/2))*30:RETURN
```

BIG BINOMIALS

Part of the formula for calculating a binomial distribution is N!/X!(N-X)!. However if N,X or N-X are much larger than 70 most computers will crash due to numeric overload. The following algorithm eliminates the need for calculating these large factorials. It assumes that N and X are positive intergers and that N is greater than X.

S Sullivan

```
100 INPUT N,X
110 T=1
120 FOR A=N-X+1 TO N
130 T=T*A/(A-N+X)
140 NEXT A
150 PRINT T
160 END
```

STOP CHATTERING WHILE READING PROGRAMS

When loading commercial software, the 1541 disk drive often makes a loud chattering noise while reading the program. This is usually caused by a copy protection technique, whereby the disk drive is forced to read a bad track or sector on the disk.

This repeated vibration of the drive's head could eventually damage the drive, or cause the stepper motor assembly to slip out of alignment.

To protect your disk drive, here is a short program to prevent bumping when going to track one. This is performed by the memory write command in the DOS.

To execute it from Basic, type in the one line program in command mode (ie without a line number) and press Return. It should be entered before loading a commercial program.

This program should be about 90 per cent effective, but there will be cases when it will not stop the chattering.

J Stromsnes

```
OPEN 1,8,15,"M-W"+CHR$(106)+CHR$(0)+CHR$(1)+CHR$(133):CLOSE 1
```

PROMPT REMOVAL FROM COMMODORE 64 INPUT

Many ways have been suggested for removing the '?' prompt from the INPUT statement on the Commodore 64. Some involve rewriting the ROM, others opening channels from the keyboard for input. Easiest is a variation on the latter using a zero page memory location. For instance:

```
10 POKE 19,1
20 INPUT "ENTER X:";X
30 POKE 19,0
```

Note that location 19 must have its contents restored.

Some other tips are: the RUN/STOP key can be turned off using POKE 788,52. Unfortunately, the jiffy clock is also turned off. The RESTORE key can be disabled with POKE 808,234, and finally, the LIST command can be disabled with POKE 744,0. Now it will list only line numbers, but using other values than 0 yields other results (the normal value is 26).

J Hainsworth

VZ-200 BUG

To the VZ-200 hackers among us this short series of program statements crashes the VZ-200 (Version 2.0).

```
10 N=1 : INPUTS : FOR
    P=1 TO S : N=N*
    P/(P+1) : ? N; : NEXT :
    RUN
```

INPUT 23 twice and the second time round the machine goes crazy.

W Tritscher

P.S. If you pay me for the above, keep it and send it to the person who provides the ROM-patch routine.

'BEE AUTO-START

The following procedure creates a copy of a Basic program that will auto-start upon loading into the MicroBee. This saves the Basic program as a machine language file, with the auto-start address 801EH.

1 Save the program as per usual.

2 Type the following line in command mode:

```
a=PEEK(248)+PEEK(249)
  *256:b=PEEK(250)+
  PEEK(251)*256:PRINT
  b,b+a
```

3 The result is two numbers: b and b+a

4 Convert these two numbers to hexadecimal, aaaa and bbbb respectively.

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5 Enter the monitor (by hitting [reset][m])
6 Type: D "filename" m aaaa bbbb 801E where aaaa and bbbb are the hex numbers you found above. Also, D gives 1200 baud recording. For 300 baud recording, replace the D with W.
7 Prepare the cassette recorder to record and press [return].

S Thompson

SPECTRUM BASIC REMOVER

This program will remove all, or at least part of, a Basic program, but will leave the variables unharmed; thus it becomes possible to change Basic programs but retain the same variables. This is most useful if you use programs which run off the same data. It's not always possible to merge such programs directly, but with one program removed the second can be merged with the first's variables.

This machine code can go anywhere in RAM — I find it best above RAM top. Users who don't have an Interface One should be able to convert it using the PRINT USR system.

If you have a hundred-line Basic program, and you wish line 50 onwards to be removed, then all you do is load the HL register pair at USR#R to hold the value 50. If you wish all the program to be removed, then load the HL register with one.

The USR function has been selected to act as the adapted calling command. The USR command, and all commands which immediately follow it, should be located on one multi-statement line; this should be the first line in the program.

If you don't have an Interface One, then remove lines 10 to 240, and lines 280, 290, 540 and 550. Change the DEFWs' at lines 300 and 560 to Call instruction's, then change the jump instruction at 580 to a RET instruction.

The enclosed Basic program is designed to allow the user to place the program above RAM top, then save it to tape. The data contains the code for the full listing of the machine code program.

N Mossman

```
00010 ;basic removal routine
00020 ;using extended basic via
00030 ; INTERFACE ONE
00040         rst   smrom       ; select ma
00050 ;                           in rom
00060         defw  get#        ; collect
00070 ;                           next char
00080 ;                           actor
00090         cp    usr         ; is it usr
00100         jr    z,usr#      ; jump if
00110 ;                           it is
00120         jp    syer        ; else synt
00130 ;                           ax error
00140 usr#    rst   smrom       ; select ma
00150 ;                           in rom
00160         defw  next#       ; get next
00170 ;                           charactor
00180         call  syfin       ; advance
00190 ;                           to end &
00200 ;                           exit if
00210 ;                           checking
00220 ;                           syntax
00230 ; the above is not needed when not
00240 ; using interface one
00250 usr#r   ld    hl,100      ; 1st line
00260 ;                           to be del
00270 ;                           eted
00280         rst   smrom       ; select ma
00290 ;                           in rom
00300         defw  addsea      ; call main
00310 ;                           rom to fi
00320 ;                           nd start
00330 ;                           of line
00340         push  hl          ; save a co
00350 ;                           py
00360         push  hl          ; transfer
00370         pop   bc          ; bc
00380         ld    hl, (vars)  ; collect
00390 ;                           address
00400 ;                           of variab
00410 ;                           les
00420         scf               ; set carry
00430 ;                           flag for
00440 ;                           correct
00450         ccf               ; subtract
00460         sbc   hl,bc       ; find numb
00470 ;                           er of byt
00480 ;                           es to re
00490 ;                           claim
00500         push hl           ; transfer
00510         pop  bc           ; to bc
00520         pop  hl           ; drop addr
00530 ;                         ess of line
00540         rst   smrom       ; select ma
00550 ;                           in rom
00560         defw recbas       ; remove
00570 ;                           basic
00580         jp    finish      ; exit in
00590 ;                           run time
00600 prog    defl 23635
00610 vars    defl 23627
00620 addsea  defl 0196eh
00630 recbas  defl 019e8h
00640 smrom   defl 010h
00650 get#    defl 018h
00660 usr     defl 192
00670 syer    defl 496
00680 next#   defl 020h
00690 syfin   defl 005b7h
00700 finish  defl 005c1h
```

```
1  REM basic loader for delete routine
10 FORMAT "t";9600: OPEN #4;"t"
20 INPUT "input start address";start:
   LET b=INT (start/256): LET a=start-b*
   256: PRINT a,b: POKE 23735,a: POKE 23736,b
30 CLEAR start: INPUT "start address?";start:
   FOR a=start TO start+40: READ c: POKE a,c:
   NEXT a
60 DATA 215,24,0,254,192,40,3,195,240,1,215,32,
   0,205,183,5,33,100,0,215,110,25,229,229,193,
   42,75,92,55,63,237,66,229,193,225,215,232,
   25,195,193,5
70 SAVE "BASIC REM" CODE start,40
99 USR
```

AMSTRAD DISPLAY TIPS

TAG — extremely useful for printing literally anywhere on the screen. However, the printing is done with the graphic pen, and what the Manual doesn't make clear is that if you want to PLOT or DRAW in one colour, then TAG and PRINT in another, you need to PLOT x,y,new col (where x & y are offscreen), MOVE back to where you were, then PRINT. This also means that you might have to restore your previous coordinates and colour to continue with PLOT or DRAW.

COLOURS — there are 32 available (see chapter nine page four of Manual). As numbers 27-31 duplicate five existing colours, only 27 are mentioned elsewhere. Nevertheless, commands such as BORDER 29 are valid.

CONTROLS — characters 0-31 (except 0 & 13) can be embedded in PRINT statements, saving quite a bit of space. For example, try PRINT"[CTRL L] TEXT" instead of CLS:PRINT "TEXT", or PRINT"[CTRL G]" to produce BEEP.

NOTE: INK & BORDER (chrs 28 & 29) should be followed by the ink number and two values, both the same if flashing isn't

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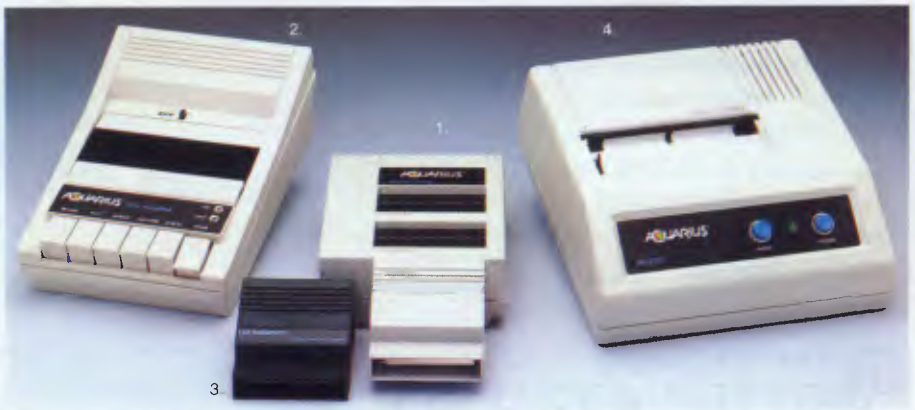

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required. If only one value is used, flashing with the value set previously will result.
HORIZONTAL SCROLLING — as display is controlled by the 6845 chip, OUT 256,No. will move the whole screen area with the edges wrapping round. Here, 'No' is a displacement from the right side, so that although OUT 256,20 moves the display by half a screen, OUT 256,39 will place the left margin at column two.
COLOUR MASKING — use of CHR$(22) with text and CHR$(23) with graphics is one of the most powerful of the Amstrad's features but difficult, perhaps, for beginners to understand in terms of the results achieved. Bearing in mind what was previously said about the PEN results of bit combination in each mode, remember that overlapping pixel colours arise from a logical combination of PEN colours. Try this:

```
10 MODE 1:INK 0,0:INK
    1,24:INK
    2,2:INK 3,15
15 GOTO 30
20 PRINT CHR$(23);
    CHR$(1)
30 FOR X=300 TO 350
    STEP 2:MOVE X,100:
    DRAW 0,150,1:NEXT
40 FOR Y=150 TO 200
    STEP 2:MOVE 250,Y:
    DRAWR 150,0,3:NEXT
```

Now delete line 15 and run again. Change INKs 1 & 3 from the keyboard and you'll see that the centre block of colour is unaffected, because the logic result from line 20 remains the same:
1XOR 3=3
(&X00000001 XOR &X00000011 = &X00000010)
(remember this is 'double width' mode — take the STEPs out of lines 30 & 40 and watch the result!).

Last, but not least, a demonstration of 'hidden line' drawing, using the same example. Having deleted line 15, EDIT line 10 and change INK 2,2 to INK 2,24 and run.

T Mayne

SIMPLE CODE CONFUSES PRYING DISASSEMBLERS

A neat trick for budding 6502 assemblers, to confuse the prying eyes of the disassemblers, is to put a few &80,&20, bytes strategically placed around your code.

This has no effect on the program at all but when the code is disassembled, the effect can be quite dramatic.

The &80 will cause the 6502 to skip the next byte, whereas the disassembler will either produce an error, or ignore it and produce the &20 as a JSR.

For example, if you had a piece of code such as:
LDA &FF[A5 FF]
and before it you had put &80,&20, the disassembled version would read:
JSR &FFA5
which is enough to confuse all but the very wary.

Note that extra instruction may not work on every 6502, as any deviations from the standard instruction set depend on the manufacturer of the chip.

D Barrett

VZ VARIABLE DEFINITION

The statements DEFINT, DEFSNG, DEFDBL and DEFSTR are not implemented in VZ-200 Basic (although the code for these is in ROM). A way of simulating these statements, without having to write great chunks of assembler, is to make use of the Variable Declaration Table located between 30977 and 31002 (7901-791AH).

The VDT is 26 bytes in length, one for each letter of the alphabet. Each location contains a code defining the status of variables beginning with each letter:

2 — integer
3 — string
4 — single precision
8 — double precision

On power up and whenever a program is RUN, the whole of the VDT is initialised to single precision (ie, each location contains a 4).

The values in the VDT may be altered to define different variable types. For example, if you wanted to define all A to Z variables as integers, you would put the following code at the start of your program:

```
10 FOR I = 30977 TO
    31002 : POKE I,2 :
    NEXT
```

This is equivalent to the 'DEFINT A-Z' statement in Level II Microsoft Basic.

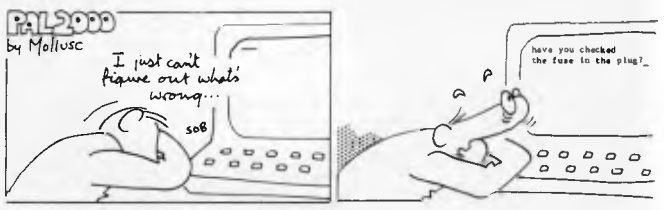
Alternatively, the following formula could be used to define individual variables:

```
10 POKE 30912 +
    ASC("Q"),3
```

(This would define Q as a string as in 'DEFSTR Q'.)

Note that Basic will not accept double precision variables as counters in FOR-NEXT loops. Also note that it is no longer necessary to use a suffix of '$' or '%' after a string or integer variable has been defined.

C Stamboulidis



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SOFTWARE

Electric Desk

Electric Desk is a cheaper integrated package designed especially for new users. Julia Newman found a sound package which makes switching between applications easy.

It has become common to group word processing packages, databases and spreadsheets together as 'executive' business applications, sold as a single integrated package. Electric Desk is another such package from the Alpha Software Corporation. This US company professes to have studied the software market for areas not covered by other software houses, but it is obviously not breaking any new ground here.

Still, the price of Electric Desk makes it interesting. At $525 for the IBM PC or XT it comes in at at least $300 less than rivals like Lotus 1-2-3 and Framework. It is not on the same level as those packages but it is easy to use. A new user will find no difficulty in moving between applications.

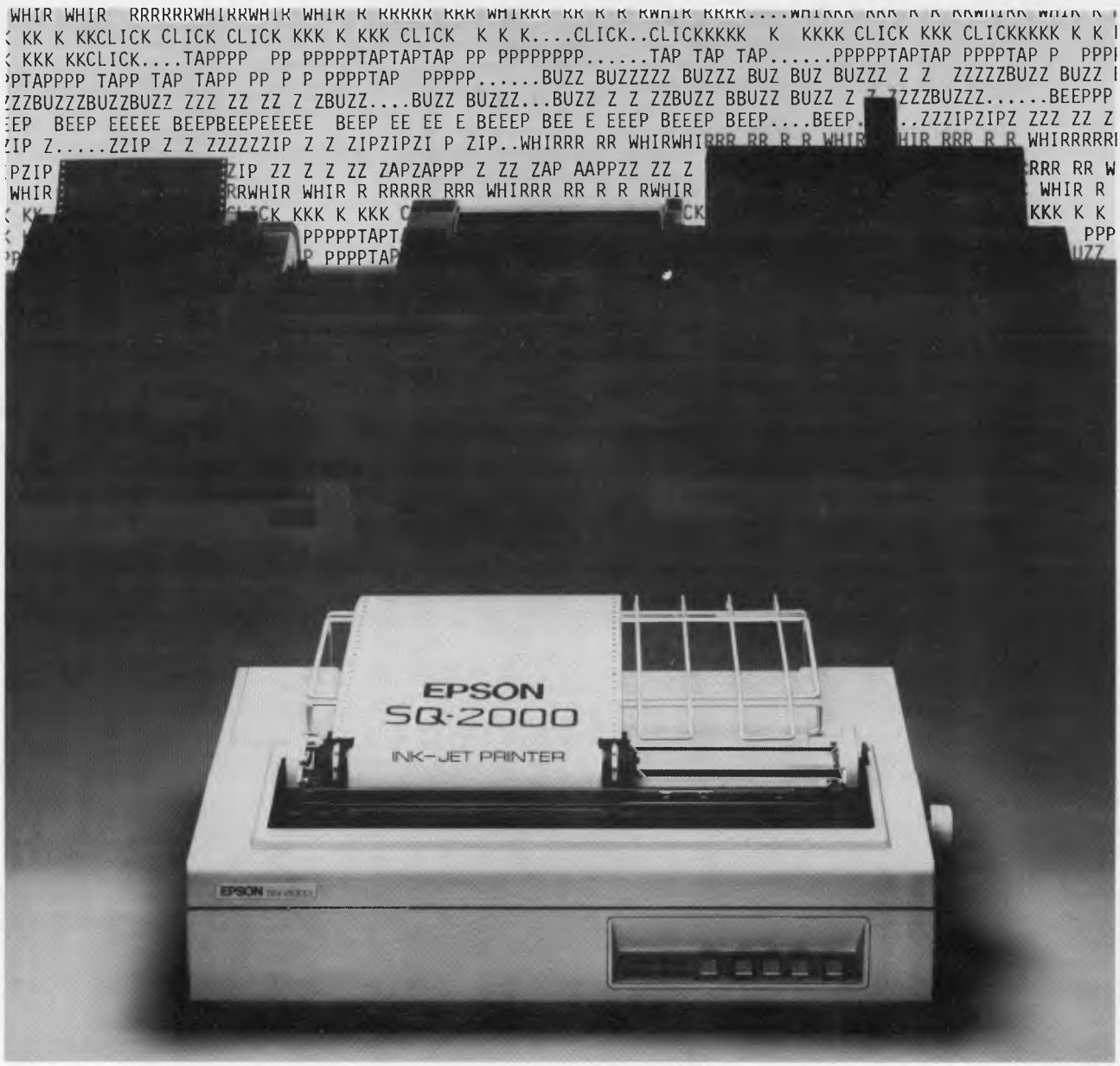
First steps

Electric Desk is supplied on a single master floppy disk, with a back-up master disk and a tutorial disk, all in a rather nifty plastic box. The manual — one volume — is well-organised and clear. Setting up was quite simple, following the manual.

Data for each of the applications can be held on the same data disk. Disturbingly, the manual does not at any point stress the importance of routinely making security copies of disks on which you have stored documents or customer records, and how to do it.

Integrated software means different things to different people. In accounting, it would normally mean that a change made in one area, for example the raising of an invoice for 30 dictionaries, would automatically be reflected in another area, for example by depleting the stock of dictionaries in the stock control file. This can also be the case, albeit more rarely, for 'executive' packages. With Framework, also for the IBM PC, it is possible to have database records and spreadsheets based on the same data, which will be recalculated throughout if a figure is changed.

More commonly, packages of this nature work by allowing you to switch from, say, database to spreadsheet without changing disks, and to transfer information from one to another. This is the case with Electric Desk. You could be typing a letter, flick to a database to con-



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firm an address, merge in some figures from the spreadsheet, copy a chunk out of a letter previously written, and print the results.

Day-to-day use of Electric Desk hinges round the concept of a 'service'. Each task tackled — from word processing, spreadsheet and database — is a service. In theory you can have up to nine of each of these types on the go at any one time, opening and closing tasks as needed.

Setting up

To get into Electric Desk you simply type ELECTRIC. The first screen — a logo and copyright page — asks you to select the service you require from: Document (word processing), Database, Spreadsheet, and Help. There is also a communications service but it is not supported in Australia at the time of going to press.

The same basic screen layout is common to all services. The service menu is present at all times on the bottom line of the screen. There are alternative ways of picking the service you require — the one you use will depend on your experience of the package.

A command menu takes up the top three lines of the screen, and shows which command will be triggered by which function keys in the service you are using. Experienced users can choose to work without the service menu, gaining three extra lines on the screen.

The IBM's function keys have the same or similar effect irrespective of the service. The key F7, for example, calls up a sub-menu of FILE and PRINT commands whether you are in the spreadsheet or the database. This consistency of approach is extended to the design of other commands — END END CURSOR DOWN in the word processor jumps the cursor to the end of the document, END END CURSOR DOWN in the spreadsheet jumps the cursor to the end of the spreadsheet.

You can back out of any bad choice throughout Electric Desk by pressing the ESC key. If you do persist in a wrong choice, the error messages are quite comprehensible.

Switching between services is very quick, presumably because all the data is held in memory, and the time taken seems no greater whether you are reselecting a suspended service or opening a new one. When you return to a task, for example, a document that you were editing, it is at exactly the same point as when you left it. You can switch from one open service to another without saving to disk, which speeds things up, though you will obviously have to save any new or edited material before closing a service or switching off.

Windowing

Not only does Electric Desk hold several tasks in memory at one time, it will also let you switch between two tasks while holding them both on the screen. The windowing command divides the available screen into two, for example editing a document in the top half of the screen and finding a record in the bottom half. You can switch from one to the other as easily as if you were using a full screen.

It is very handy when using any command that prompts for a file name — creating a new file on disk, retrieving an existing file, printing a file — to be able to call up a display of the disk directory in a box on the right of the screen, which can then be used as a picking list. You use the cursor to move to the file you want and press the Return key.

A couple of points about directories, however. If you are in the word processor, the only files listed are documents, so if you want to see what spreadsheets you have, you need to switch into that service. This is because Electric Desk uses its own system of file name extensions, hidden from the user.

Because of this, the manual warns, if you use your own extension when naming a file, (people used to Wordstar, for example, might from habit name a letter SMITH.LTR, .LTR being the extension) then this file will not be included in the directory listing, and you would have to remember or keep a separate note of the name, or check the directory with an operating system command. The same would apply if you wanted to use a document created using another package from within Electric Desk.

The directory listing does not show the amount of space left on the disk. This can be found out by using an 'environment command'. Other environment commands common to all services are the window size selection, erase screen, close service and set colours.

This last is for those with a colour monitor on their IBM, who can select different colours for different elements on the screen, foreground and background. In the spreadsheet this means that headings and numbers can be a different colour from the basic grid, and in the database the field headings can be distinct from the data itself. The word processor gives you the scope for creating a very colourful document-on-screen at least, with a different combination of foreground and background for each of eight possible type styles.

Memory keys

As soon as you have mastered the basics of Electric Desk it's fun to have a stab at creating macros, or memory keys — a little tricky at first but very useful. Memory keys are like function keys you program yourself so that a single key (actually two pressed simultaneously) has the effect of a whole sequence of keys. This may be a word, or phrase (up to 1,000 characters), or a sequence of commands that you type again and again.

There is no complicated programming language to learn — you simply press the ALT and F10 keys to get into the macro facility, type the keys you want to assume the new value, then the sequence of keys to pack into the macro, exactly as if you were trying to execute that sequence, then ALT and F10 to end. Memory keys retain their value until they are redefined — you don't have to create a new set at the start of each session.

Memory keys are available for all 'services'. A distinction is made between system-wide keys — up to ten at any one time — and service-specific keys — up to 26. A useful system-wide memory key might be one for 'call help on this topic', a word processor specific one could be 'Azed Computers Pty Ltd'. The memory key facility is powerful and can streamline work by reducing the number of keystrokes needed for any one operation — providing you can remember which keys you have programmed, and how.

Electric Desk also provides a small set of 'embedded' commands for use with the word processor and spreadsheet, to affect the style of printed documents and reports. >.Date Today< would insert today's date into a form letter, and >.Header Text January 1985< would place the words January 1985 at the top of each printed page. The instruction to print only selected pages of a document is also embedded as a command in the document rather than specified at print time.

Printing can be done without leaving the current service, but you will find that if you want to use the 'look-up' facility to select the file to print, it will only show you those pertinent to the service you are in, so you may have to switch out of the database if what you want to print is a spreadsheet.

Help

The help for Electric Desk is, on the whole, very good. At any time you can choose whether help is context-based or not. When context-based help is 'on', the

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initial help screen relates to the task you were involved with immediately before. If context-based is 'off', you use a function key to state which service you need help with, and then choose from a range of topics. Each help page has a reference to the manual section for that topic.

Once you get over the initial feeling of gratitude for the existence of a help facility, it starts to seem a bit cumbersome, though it is fast to load. Even with context-based help 'on' you can not simply hit one key and get help — you have to hit a function key to get the service menu then choose the help service. The same is true when returning to the work area from help. This is the sort of circumstance in which you might consider defining memory keys. Alternatively a case could be made for having a dedicated Help key.

One nice aspect of help is that you can window it — cut it into the bottom half of the screen while keeping a spreadsheet you are having trouble with in the top half.

Word processing

The 'Document Service' is pleasant to use — the function keys and prompts take the load off the new user — and provides most of the word processing basics.

The Search and Replace facility is on the clumsy side; the 'selective' Search and Replace is badly designed — not replacing automatically throughout the document but locating each occurrence of the search string and giving you the opportunity of considering it in context before replacing. The function first finds the word and changes it, and then leaves the cursor on the word in case you want to change it back!

Plus you have to re-enter the Search and Replace facility each time you want to move to the next occurrence of the search string, which involves four keystrokes, and similarly when hunting for a string without setting a replacement.

A ruler line across the bottom of the screen shows the position of the cursor relative to tab and margin settings. When you change a left or right margin setting, the whole of the document is immediately reformatted to the new settings. Though it is sometimes tedious to reformat a document paragraph by paragraph, as with a package like WordStar, there are certainly circumstances where you wish to change the layout of a document purely from the cursor position onwards, or to go back in the document and change the appearance of just one paragraph.

You do not seem to be able to justify text to the right hand margin, which is standard on quite simple word processors. Features which are included in Electric Desk and are a bit of a luxury are the facility to change a character from upper to lower case or vice versa, and to transpose two adjacent mistyped characters.

You can show underlining and different character fonts on the screen, if your IBM screen has these facilities.

Database

The database can occasionally be a little cumbersome to use, though the manual suggests that you might like to create memory keys for functions like 'Get next record'. The user defines the structure and contents of the record, which are labels used by the user and the database in searching and indexing the data itself, and comments. The user can also influence the way the record appears on the screen.

The maximum length of a record is 1,000 characters. There may be up to five indexes for each database, An index is used to look for a record which matches, or most closely matches, a key word, and then to move backwards and forwards through the index. Databases often only have one index, and the user decides what will be the key word when planning the structure of the record. The Electric Desk database works differently; you first set up the records, and can then use the MAKE INDEX command to decide what indexes to make. A sales department's prospect mailing list could be indexed by company name, contact

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name, and postcode, for example.

We found it a relatively easy procedure to create a new, longer record format, and to transfer all your existing records into the new database format.

A disconcerting feature is that when you have finished editing a record and press the Return key the cursor drifts to the bottom of the work area — it would be better for the cursor to wait on the last available line of the record.

Spreadsheet

The Electric Desk spreadsheet has a conventional appearance. The maximum size of the spreadsheet is 255 columns by 255 rows — nothing like the potential size of a spreadsheet in Lotus 1-2-3, but bigger than some. A SPACE command tells you how much space you have left when creating a spreadsheet.

A standard spreadsheet feature is that you define a relationship between sets of figures, for example SALES — COSTS = PROFIT, and if you change any SALES figure, the PROFIT figure will be adjusted accordingly without any intervention from the user. The Electric Desk manual warns that this recalculation gets slower if it applies over a very large spreadsheet.

Many spreadsheets and integrated packages have a graphics function, which may be part of the spreadsheet, or a separate facility. Figures from the spreadsheet can be converted to graphical form — a pie chart, or line graph, for instance. Electric Desk does not incorporate such a feature.

Tutorial

The tutorial is by no means a complete introduction to every feature of Electric Desk — it shows the new user how to use some editing commands, how to modify certain figures in the spreadsheet by pointing the cursor or using simple forumlae, and how to merge a defined area of the spreadsheet into a letter. It's really more to give you the feel of the package.

The tutorial first takes you through a little scenario of a difficult business situation, and how Electric Desk helps you get out of such a situation by holding the information you need close at hand. The tutorial simulates the keystrokes, and gives a running commentary on the actions taken and the prompts which appear on the screen of the microcomputer.

You then proceed to what appears to be an 'interactive' tutorial. This uses an area of the screen for the narrator's instructions. You, the pupil, press keys as instructed and follow the resulting changes in the command and service lines. The result is quite effective, though you soon find out that the tutorial is not truly interactive — pressing any key has the same effect as pressing the designated key, so lazy learners can go through simply pressing the space bar, which means they won't gain much by the tutorial.

Conclusion

Given the price, Electric Desk is worth considering for people who want to make light use of an 'executive' business package which will present no problems to learn.

One small reservation is that the backing up of data disks is not covered anywhere in the manual or help information, or in any of the menus. Back-up is so fundamental that it wouid not be overkill to include it on the main service menu, or indeed on each of the service submenus.

The manual warns that if you try to open more services than can be handled by the memory of your computer, you may be told 'Insufficient memory available'. We found that with a 256k machine, memory ran out after opening one longish document and one short one, or three short documents, two tiny databases and two little spreadsheets. In use this would not be a problem: closing and reopening a service is not difficult or time-consuming. Users with heavier requirements would have to think about using more memory than 256k.

Electric Desk is imported and distributed in this country by Software Corporation of Australia. It retails for $525.

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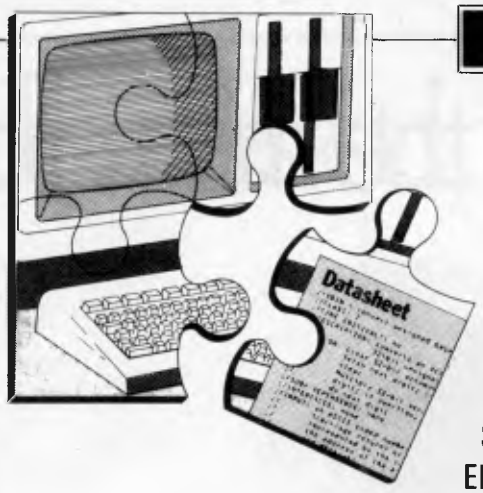

SUBSET

David Barrow presents more documented machine code routines and useful information for the assembly language programmer. If you have a good routine, an improvement or conversion of one already printed, or just a helpful programming hint, then send it in and share it with other programmers. Subroutines for any of the popular processors and computers are welcome but please include full documentation. All published code will be paid for. Send your contributions to Sub Set, APC, 77 Glenhuntly Road, Elwood, Victoria 3184.

SCREENDUMPS

Barrie Frost would like to see the best method of converting high resolution screen graphics information to the Epson printer 'bit mode' form.

To operate in the normal-density bit image mode, Epson printers must receive the control codes $1B, $4B. This is followed by two bytes — low-order byte sent first — giving the number of bit image data bytes (maximum 480 or $1E0) to follow. Each byte of bit image data represents eight vertical dots with bit 7 as the top dot and bit 0 the lowest dot. This produces a maximum resolution of 480 dots wide by eight dots high in one pass of the print head, as in Fig 1.

Byte:	1	2	3	4	.	.	.	477	478	479	480
	7	7	7	7				7	7	7	7
	6	6	6	6				6	6	6	6
	5	5	5	5				5	5	5	5
Bits:	4	4	4	4	.	.	.	4	4	4	4
	3	3	3	3				3	3	3	3
.	2	2	2	2				2	2	2	2
	1	1	1	1				1	1	1	1
	0	0	0	0				0	0	0	0

Fig 1

All memory-mapped high resolution screens, however, treat the bits in each byte as a horizontal sequence of dots. There are wide variations in the number of dots that are encoded in each byte, and in the physical arrangement of the bytes onscreen.

The most straightforward representation is shown in Fig 2 (the source screen for this exercise). It's based on a monochrome display of 40 characters by 24 lines. Each screen character occupies a matrix eight dots square — one byte wide by eight bytes high. This gives a graphics resolution of 320 dots wide and 192 dots high with a total of 7680 bytes.

The first byte of bit image data sent to the printer must be built up from the highest bits (all bit 7s) of graphics screen bytes 1, 41, 81, 121, 161, 201, 241 and 281. The second data byte will be composed of all bit 6s from the same series of screen bytes, and so on. The ninth data byte will hold all bit 7 information from screen bytes 2, 42, 82, 122, 162, 202, 242 and 282. The last data byte sent to the printer will be composed of the low order bits (all bit 0s) of graphics screen bytes 7400, 7440, 7480, 7520, 7560, 7600, 7640 and 7680.

(byte:1) bit:76543210	(byte:2) bit:76543210	.	.	.				(byte:40) bit:76543210
(byte:41) bit:76543210	(byte:42) bit:76543210	.	.	.				(byte:80) bit:76543210
.	.	.	.	.				.
(byte:7641) bit:76543210	(byte:7642) bit:76543210	.	.	.				(byte:7680) bit:76543210

Fig 2

To ensure that vertical spacing is equalised, the line spacing must be set to 8/72 in; this is done by sending the three control codes $1B, $41 and $08 before the screendump begins. Each line of eight vertical dots should terminate with a carriage return (code $0D). To centre the dump on standard 241mm listing paper, each line should begin with 80 zero bit image bytes.

Assume a routine 'PRNTER' which deals with all communications between printer and computer. All control and data bytes to be output to the printer should be sent through this subroutine.

PRNTER accepts one data byte input in an 8-bit accumulator and does not change any register contents. Because the operation of the printer can be expected to be far slower than that of the screendump routine, speed is not a high priority.

SECURITY CODING

DPRO (Datasheet 1) from Roy Easto uses a pseudo-random sequence to encode a block of data. Each successive byte in the data block is exclusively-ORed with the next value in sequence.

The security depends on inputting a 16-bit security code as the initial random value, or 'seed'. Greater security could be built in by having several pseudo-random number generators to choose from, depending on a second input code. DPRO uses just one routine, RNDM2, which can be found in *APC*, February 1983. Alternatively, a 32-bit generator could be used — again one can be found in the 1983 issue.

As pseudo-random sequences repeat exactly, DPRO will encode a block of raw data or decode already encoded data. Successful decoding can only be carried out by inputting the same security number as that used for the initial encoding.

The encoding process may be repeated several times with a sequence of different security numbers. No matter how many levels of encoding are used, the data can be recovered by using the reverse sequence of seeds.

DATASHEET 1

```
:=================================================================
:= DPRO      Data block protection by encode/decode.
:=================================================================
:JOB         To encode or decode a data block by exclusive-oring
:            each byte with one byte from each new value obtained
```

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```
:            from a pseudo-random sequence.
:ACTION      Use input security number as pseudo-random seed.
:            FOR each byte in data block:
:            [ Compute next pseudo-random number.
:              Exclusive-OR data byte with random number byte. ]
:-----------------------------------------------------------------
:CPU         Z80
:HARDWARE    RAM containing data block.
:SOFTWARE    RNDM2 - 16-bit pseudo-random number generator.
:                    Input (last number or seed) in HL.
:                    Output (new random number) in HL.
:                    No other registers affected.
:-----------------------------------------------------------------
:INPUT       DE addresses first byte of data block.
:            BC = number of bytes in data block.
:            HL contains a security number (pseudo-random seed).
:OUTPUT      DE addresses byte at block +1.
:            A = BC = 0. HL contains random value. F is changed.
:            If input data was unencoded, it is encoded on exit.
:            If data was encoded on entry and HL contained the
:            correct security number, it is decoded on exit.
:ERRORS      None.
:REG USE     AF BC DE HL
:STACK USE   2 + RNDM2 stack use.
:RAM USE     None.
:LENGTH      13
:CYCLES      (67 + RNDM2 cycles) per data byte + 5.
:-----------------------------------------------------------------
:CLASS 2       -discreet       *interruptable      *promable
:-*****        *reentrant      *relocatable        *robust
:=================================================================
:
DPRO    CALL RNDM2   :Get next sequential number          CD lo hi
        LD   A,(DE)  :Pick up next data byte from block   1A
        XOR  H       :and encode/decode with current      AC
        LD   (DE),A  :random value, then replace it.      12
        INC  DE      :Index next byte in data block.      13
        DEC  BC      :Count off byte just coded or        0B
        LD   A,C     :decoded, then test for all          79
        OR   B       :bytes processed, repeating          B0
        JR   NZ,DPRO :until completion.                   20 F4
        RET          :Exit, data encoded/decoded.         C9
:=================================================================
```

PARALLEL MOVES?

Last month I dismissed a suggestion by Hugh Dobbs that intelligent transfer routines should perform the data move even if the source is at the same address as the destination. The routine that prompted Hugh's suggestion was IBTZ8, printed in *APC*, October 1984; the reason for this apparently meaningless transfer being that the system might support parallel blocks of memory.

My response was that the automatically repeating LDIR and LDDR instructions cannot be adapted to switch banks between the read and write operations.

Hugh has written in with the observation that it's possible, on the Apple, to copy data between parallel ROM and RAM banks. This is achieved by separate soft switches for 'RAM write-enable' and 'RAM read-enable/ROM read-disable'. He sees no reason why the method can't be implemented on a Z80 system, thereby allowing the block moves to be used for parallel bank transfers.

Further discussion on this interesting topic will be very welcome.

Z80 FRAMES

In the early days of SubSet we developed a more or less efficient pair of routines, PUSHM and POPEM, to save and restore the Z80 register set. These could be called on entry to and on exit from any routine, offering a considerable saving in bytes and programming time.

ENTRY (Datasheet 2) and EXIT (Datasheet 3), both from Keith Bremer are similar in concept to PUSHM amd POPEM but with a subtle difference. With ENTRY called at the start of a subroutine and EXIT jumped to at the end, they both save registers and provide an index to the stacked values throughout the intervening subroutine. Furthermore, 128 bytes below the stacked registers can also be indexed by using negative displacements to IX. Any stack used in the subroutine which called ENTRY need not be tidied up, since this is done automatically by the jump to EXIT. A call, rather than a jump, to EXIT will not produce a stacking error, since the return address is lost when the stack pointer is loaded from IX.

The concept behind these routines is known as 'framing': the subroutine is automatically allocated its own section of stack memory, or frame, for use as workspace. The address in IX is the 'frame top'. The framing process is not complete in ENTRY/EXIT due to the stack pointer not being adjusted to clear the workspace (as, for example, the 68000's stack pointer is in the LINK/UNLINK instructions).

One possibility afforded by ENTRY is the use of both index registers to good effect by returning the address of the subroutine as well as the frame top; data appended to the subroutine may then be indexed. As the subroutine address is loaded into IX by the first instruction, IX becomes the code index and JP (IX) can replace the RET. In the last three instructions involving IX which set the frame, IX can be replaced by IY, making it the frame pointer. EXIT has to be changed correspondingly.

DATASHEET 2

```
:=================================================================
:= ENTRY     Frame entry, saving registers.
:=================================================================
:JOB         When CALLED at the start of a subroutine, to save
:            the register set, index stack and return to the
:            calling subroutine.
```


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```
:ACTION      Exchange index register with return address.
:            Push other registers.
:            Push index register (return address).

:            Index stack at last register pushed.
:-------------------------------------------------------------------
:CPU         Z80
:HARDWARE    None.
:SOFTWARE    Written to act as opening subroutine to the EXIT
:            closing subroutine.
:-------------------------------------------------------------------

:INPUT       None.
:OUTPUT      IX, AF, BC, DE and HL are saved on stack (IX in
:            highest memory).
:            IX = SP.
:ERRORS      None.
:REG USE     IX
:STACK USE   10
:RAM USE     None.
:LENGTH      15
:CYCLES      121

:-------------------------------------------------------------------
:CLASS 1     *discreet      *interruptable      *promable
:******      *reentrant     *relocatable        *robust
:===================================================================

:
ENTRY  EX   (SP),IX :Save IX, getting return address DD E3
       PUSH AF      :to subroutine calling ENTRY.    F5
       PUSH BC      :Save register set AF, BC, DE    C5
       PUSH DE      :and HL (or extend this part to  D5
       PUSH HL      :save alternate regs. and IY).   E5
       PUSH IX      :Return address on stack top.    DD E5
       LD   IX,2    :Account for return address and  DD 21 02 00
       ADD  IX,SP   :index top of stack.             DD 39
       RET          :Return to calling subroutine.   C9
:===================================================================
```

DATASHEET 3

```
:===================================================================
:= EXIT      Frame exit, restoring registers.
:===================================================================

:JOB         When jumped to, or called, at the end of a
:            subroutine, to tidy stack, restore registers and
:            exit to the calling program.
:ACTION      Move index register to Stack Pointer.
:            Pop other registers.
:            Pop index register.

:-------------------------------------------------------------------
:CPU         Z80
:HARDWARE    None.
:SOFTWARE    Written to act as closing subroutine to the ENTRY
:            opening subroutine.
:-------------------------------------------------------------------

:INPUT       IX addresses frame stack top.
:OUTPUT      Registers saved by ENTRY are restored from memory at
:            input IX.
:            SP = input IX + 12.
:            Return made to program calling subroutine which
:            jumped to EXIT.
:ERRORS      None.
:REG USE     HL DE BC AF IX.
:STACK USE   None (ENTRY stacking cleared).
:RAM USE     None.
:LENGTH      9
:CYCLES      74

:-------------------------------------------------------------------
:CLASS 1     *discreet      *interruptable      *promable
:******      *reentrant     *relocatable        *robust
:===================================================================

:
EXIT   LD   SP,IX   :Reset Stack at saved registers.      DD F9
       POP  HL      :Restore registers saved by ENTRY     E1
       POP  DE      :(this section must match the         D1
       POP  BC      :pushing in ENTRY).                   C1
       POP  AF      :                                     F1
       POP  IX      :Restore index register and exit to   DD E1
       RET          :higher level program.                C9
:===================================================================
```

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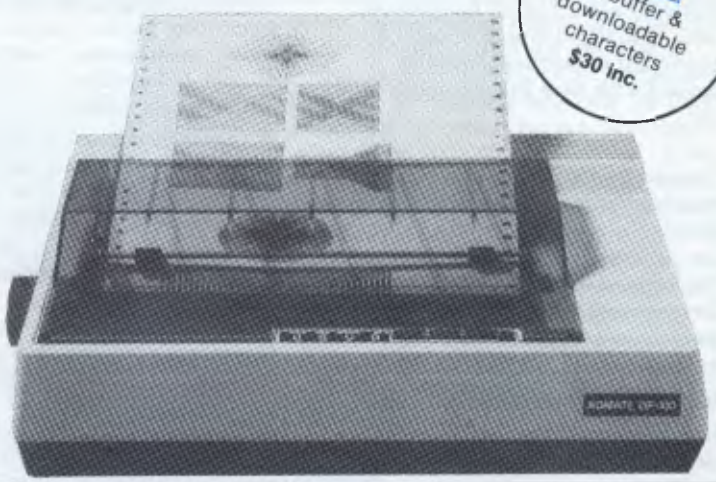

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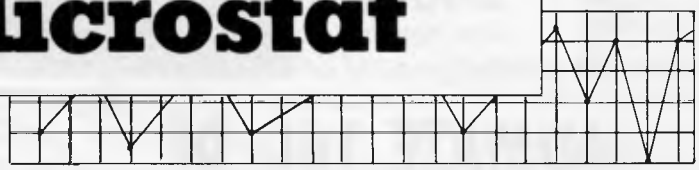

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Functional C

Les Hampson reveals everything you need to know about C functions, from basic patterns to changing variables.

Functions in C are comparable with the procedures of Pascal, or with the built-in functions of Basic like mid$, sin and inkey$, except that you can write your own of any complexity to add to those provided. The most used functions, for example for file and display access, are supplied in a library with the compiler.

A simple function called 'spaces' to blank part of a line on a display is illustrated in Fig 1. Once this has been defined, it can be used anywhere in a program simply by calling it by name with the number of spaces required: for example, spaces (10).

Only one value is passed to this function, but others might accept none or a list of arguments. One function can call others which can call others, and so on; the example calls a standard library function, putchar, to display each space. A function can also return a value which can then be assigned to a variable or used in any other way. The standard library function, getchar, returns a character entered at the keyboard: for example, c=getchar().

Of course, a returned value can be ignored if it suits your purpose, and you might use the statement getchar (); so that the user presses a key before a program continues.

Advising on how large functions should be might seem like discussing the length of pieces of string, since clearly they can be as short, or long, as the job requires. But a rule which works well in practice is that functions should be less than 60 lines. This arbitrary limit means that each function will fit a sheet of print-out and read as a whole. In fact, many functions will be short enough to fit on a display screen. If you produce a program with a massive main function, then you should probably reconsider how it is structured. It's perfectly reasonable to have a main function of only a few lines which just controls the principle parts of a program.

```
spaces(number)
int number;
    {
    while(number-- !=0)          /*loop until counter is zero*/
            putchar(' ');
    }
```

Fig 1 Function to display spaces

```
double square(x)            /*type specifies double returned*/
double x;                   /*declare argument passed*/
    {
    double result;            /*local variable*/
    result=x*x;               /*calculate result*/
    return result;            /*return result*/
    }
```

Fig 2 Specimen function

```
range(x)
unsigned x;
    {
    int rval=2;      /* for values>=32768 */

    if(x<256) rval=0;
    else if(x<32768) rval=1;
    return rval;
    }
```

Fig 3 Returning values

Basic pattern

The basic pattern for a function is:

```
type function-name
  (list-of-argument-names)
    argument-declarations
    {
    local-data-declarations
    statements
    return value
    }
```

The only restriction is that one function cannot be defined inside another, so local procedures cannot be used. The only essentials are the name, the following brackets and the braces, giving something which would do nothing. For example:

```
myfun ()
    {
    }
```

A rather artificial function with all the components is shown in Fig 2.

The type of a function is the type of the value returned and can be left out if it does not return anything. The type can be int, long, double, and so on, although int can be omitted as it's the default.

The name of the function is followed by a list of names which will be used *internally* to refer to the arguments passed to it. The types of these arguments are declared followed by the body of the function, which is enclosed in braces. Local data is declared before any statements and, unless this is specified as static, it disappears on finally leaving the function. After executing the statements, a function is exited either by reaching the final brace, or by a return statement which can be followed by a value to send back.

Data

A function is called by name with a list of values to be passed in brackets; these can be variables or constants. For example:

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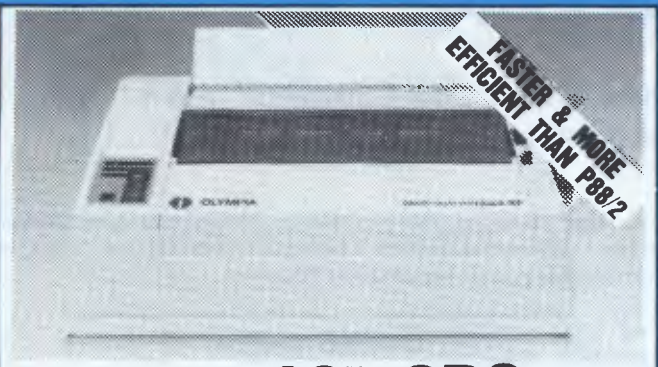

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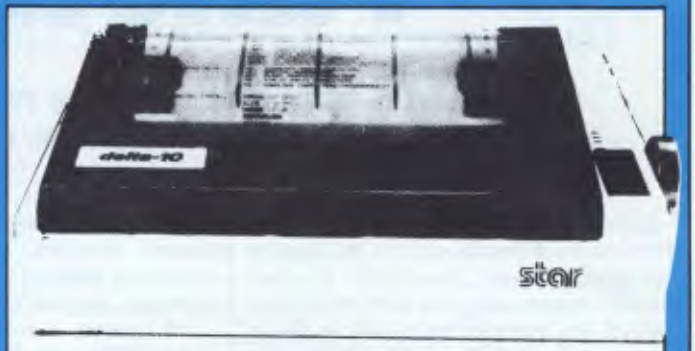

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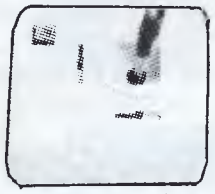

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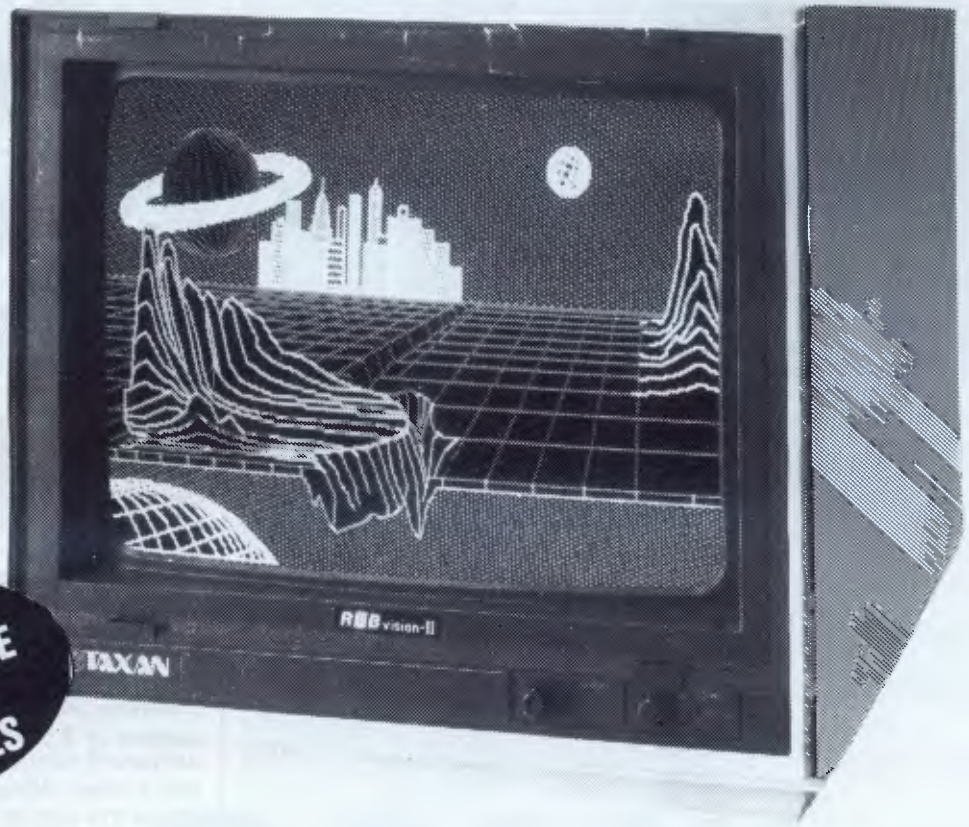

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```
/*
PROGRAM to give dump of a file in hex and ascii
usage example: A>DUMP B:FILENAME.EXT
*/

#include "stdio.h"
#define EOF -1
#define FERROR 0
#define BLOK 8

main(argc,argv)
    int  argc;                          /*number of arguments*/
    char *argv[];                       /*array of pointers to arguments*/
    {
    FILE *infile;
    unsigned i,total=0;
    int c=0;

    if (argc < 2)
            {
            puts("Missing Filename\n");
            exit();
            }


    if ((infile=fopen(argv[1],"r")) == FERROR)
            {
            puts("Cannot Open ");
            puts(argv[1]);
            exit();
            }


    while(c!=EOF)                       /*starting point of loop*/
        {
        showord(total);                 /*display offset in hex*/
        puts("      ");

        for(i=0;i<BLOK;i++)              /*read and display set of bytes*/
            {

            if ((c=getc(infile))== EOF) /*read a char from the file*/
                        break;          /*exit at end of file*/
            display(c);
            }
       puts("\n");                      /*start a new line*/
       total+=BLOK;                     /*increment offset*/
       }
    }

    /* display a byte */
display(ch)
char ch;
    {
    shobyte(ch);            /*display char in hex*/
    putchar(' ');

    if(ch>=' ' && ch<='~')  /*is char printable*/
            putchar(ch);    /*then display it*/
    else
            putchar(' ');   /*otherwise a space*/

    putchar(' ');
    }

    /* print a word in hex */
showord(wrd)
    unsigned wrd;
    {
    shobyte(wrd>>8);                    /*display high byte*/
    shobyte(wrd);                       /*and low byte*/
    }

    /* print a byte in hex */
shobyte(byt)
    char byt;
    {
    shonib(byt>>4);          /* two hex chars needed for byte */
    shonib(byt);
```

Fig 4 Example program

program continues

```
square (z);
sqrt (3.6);
putchar ('A');
puts ("Your message could go here");
strcmp (str, "testing");
```

Only the values of arguments are passed and made available to the called function. This means that a function can modify the values in any way required, for example as a decreasing loop counter, and will not affect variables in the calling function. A called function simply copies the values and makes them available as values in local variables, with their own names.

This is an important point which affects how C functions manipulate data. You might wonder about character strings and other arrays since there is no obvious value. These are treated somewhat differently with the address in memory being passed, but this is best considered as the mysteries of pointers unfold.

As well as its type, every variable has an associated storage class which determines how it will be kept in memory. Local data is available within the function in which it is defined and nowhere else — not even in other functions called from it. The default for local data is auto, which means that the memory is released and the value lost when the memory is finally left. When you need to retain a value for the next time a function is called, this can be done by using the specifier static. You might also use this to retain a count of how many times a function has been called.

Another alternative is to specify a local variable as a register to indicate that it will be very frequently used, perhaps as a loop counter. Many micro versions of C ignore this hint to store it in one of the registers because of the limited number available.

A single value can be sent back to the calling function by a return statement. This can use a variable or constant, or can involve an expression which is first evaluated. For example:

```
return 0;
return x;
return (x>y)?x:0;
```

Return statements can occur anywhere in the body of a function. Since they disrupt the logical structure, it's best to use a local variable called, say, rval, which is sent back by a single statement as in Fig 3.

A function call 'leaves behind' its returned value, just as an expression does when evaluated. This means that a function call can be used anywhere a value is acceptable: in an assignment, as part of a complex expression or comparison, or as an argument for another function call. Consequently, it is inevit-

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```
    }

    /* print a nibble as a hex character 0-9 A-F */
shonib(nib)
    char nib;
    {
    nib&=15;
    putchar((nib >= 10) ? nib-10+'A': nib+'0');
    }

/*          Sample output

0000      0D    0A    2F /  2A *  0D    0A    50 P  52 R
0008      4F O  47 G  52 R  41 A  4D M  20    74 t  6F o
0010      20    67 g  69 i  76 v  65 e  20    64 d  75 u
0018      6D m  70 p  20    6F o  66 f  20    61 a  20
0020      66 f  69 i  6C l  65 e  20    69 i  6E n  20
0028      68 h  65 e  78 x  20    61 a  6E n  64 d  20

Library functions used
fopen           open a file for reading or writing
getc            get next character from a file
putchar         display a character
puts            display a string
exit            exit program
*/

/*open file for reading*/
```

able that only one value can be returned. You could use:

```
x=sqrt (3.6);
x=sqrt (sin(3.6));
if(getchar()=='a')
x^ =rand ();
```

If a function returns a type other than int, then this must be specifically declared before it is used. This is done in a similar way to a data declaration, except that the function name is given with empty brackets. The declaration must correspond to the type specified in the function definition. It is usually convenient to declare all the functions which return non-integers at the start of a source file, so that they are known throughout. For example, the standard maths functions return a double, so must be declared before use:

```
double sqrt (); /*square root
  function*/
double y,x=0.7;
y=sqrt (x);
```

Since the type char is converted to int in expressions and all floating point operations are in double precision, the types used for function declarations need only be int, long, double, or a pointer. The default is int so does not have to be declared and often isn't, although it's good practice to do so.

There must be the expected number of arguments passed to a function and these must be of the expected type and in the correct order; for library functions the requirements will be described in the reference manual. Sometimes we want to use an 'incorrect' type and so must massage the value of our data into the required type using a cast, which is simply a type name in brackets:

```
int x=8;
double sqrt (),y;
y=sqrt ((double)x); /*force value of x
  to double*/
```

If a function requires a long argument and you want to use a constant, use the L suffix as in:

```
lseek(myfile,256L,0);
```

The function lseek is in most libraries and adjusts the position in a file, where the next data will be accessed to give random access. The second argument needs to be a long because it determines the position, and files can be bigger than allowed by an unsigned value.

The C compiler will give no protection against errors involving data types. The program will usually carry on regardless, so if a function expects a double then it assumes one has been provided and will grab what it can from the expected place in memory. If you used sqrt(x), in the example above, then the answer would be meaningless.

The stack

It is useful to have some insight into the mechanics of calling a function, especially how the stack is used. This is simply an expandable area of memory, where values can be added to the top and taken off as required; the size goes up and down as the stack is used. A good analogy is a pile of paper on a spike. When a function is called, the normal process is for the arguments to be placed on the stack, right-most first, then information on how to return, and finally, any space required for local auto variables is allocated. All of this section of the stack is moved on, leaving the function to restore the initial condition. Special arrangements are sometimes made for floating point arguments.

Static variables are not held on the stack but in an area of the memory reserved for permanent data. The compiler ensures that these variables are only accessible from within their functions and that there is no conflict over names.

When values are returned, they are placed in a consistent way according to their type: for example, in one or more registers. The returned type must be declared so that the value can be correctly accessed.

Any function can call itself without conflict of argument or local variables. All that happens is that a new section of the stack is allocated for each call. If this continues, then eventually there will be no memory available and the program must abort. Recursion can lead to very succinct programs, especially when using data structures like linked lists.

There is a standard library function, (printf), to display all kinds of formatted output, but as an example we can write a recursive function to display a decimal number. This can't be done directly, since the first character to display is the last available as we repeatedly divide by 10:

```
numsho (num)
    unsigned num;
    {
    unsigned quot,rem;

    quotum/10;
    rem=num%10;
    if(quot!=0) numsho (quot);
    /*recursion until no remainder*/
    putchar (rem+ '0');
```

The function putchar accepts an argument which is the ASCII value of a character to be displayed. So to use it to display a digit, we need to add the value of rem to '0'.

Changing variables

Any function can make changes to global data items since these are accessible by name. Some global data, needed by many functions, will be used in most programs and this is preferable to long lists of arguments. However, in general, values should be passed between functions using arguments and a returned value, and local variables used. In most versions of Basic, all variables are global; a common problem is that a change to a variable in one part of a program has unexpected side effects on another.

A function cannot directly change local variables in another function, including the one which called it, nor can it return several values. However, we often want to do just that. For example, you might

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want a function to exchange the values in two integers but cannot use

```
exchange (x,y) /*this does
  nothing*/
    int x,y;
    {
    int temp;

    temp=x;
    x=y;
    y=temp;
    }
```

This will have no effect on the original variables because only their values are passed as arguments. What is needed is to pass values which enable the required variables to be accessed, specifically their addresses in memory. This leads us into the use of pointers which will be considered next month.

Main function

Every program must have a function called main where execution begins. This can have arguments which are provided, not by another function, but by the call to the program. For example, if a program is invoked by entering myprog arg 1 arg 2, then the two arguments, and in Unix the program name, are available ~ to ~ main. By convention the arguments are declared as follows:

```
main (argc,argv)
  int argc; /*the number of
  arguments*/
  char *argv[]; /*array of pointers
  to strings*/
  {
```

You will be able to access the command line arguments after getting to grips with pointers. Since they are local to main, they have to be made available to other functions by passing their values or copying to global variables.

As well as learning C by writing simple programs and trying them out, it is also useful to see examples from other programmers. The program in Fig 4 illustrates some of the features of C which have been described and it might even be useful. The file name is passed to the program as an argument and is available as argv[1].

This is part three of a five-part Teach Yourself series. Back issues can be obtained from our office at 77 Glenhuntly Road, Elwood, Victoria 3184.

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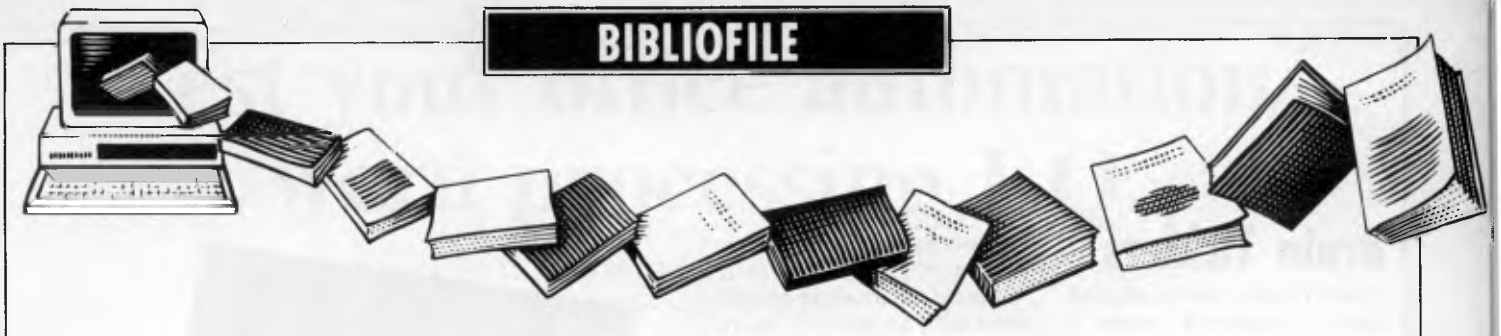
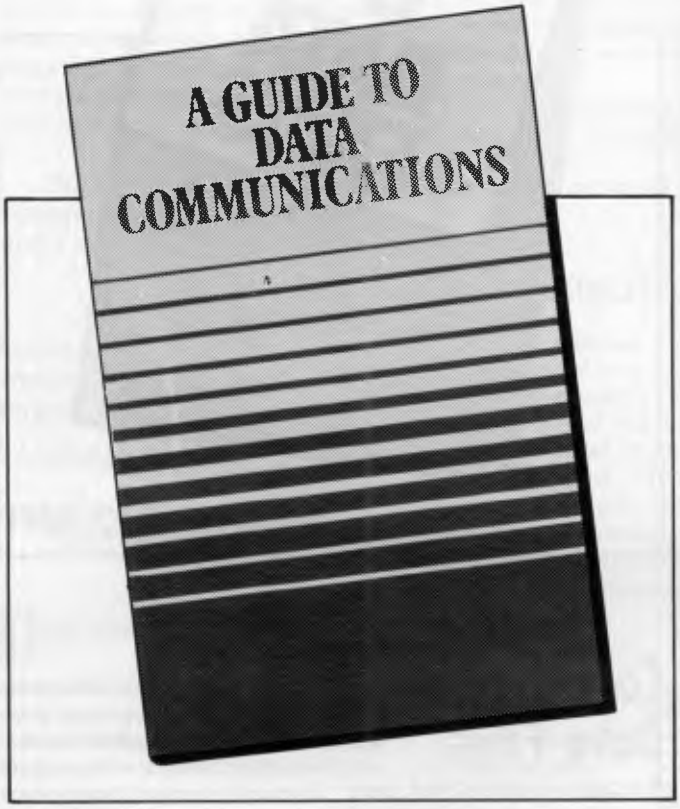


Steve Withers is joined by David Taylor this month to look at the more notable (but not necessarily worthwhile) titles received at APC's offices.



A Guide to Data Communications

This book is unmistakably a textbook. That's not meant as a criticism, merely a statement of fact. It's also unmistakably English, making the book doubly different from the usual American mass-market publications I normally receive for review.

As textbooks go, this one is very readable. Starting with an explanation of the need for data communications it progresses through a very clear explanation of the basic concepts of communication and telephone signalling (one of the most common ways of moving data from one site to another is through telephone lines). Once this groundwork has been laid the author turns his attention to some of the various kinds of network.

The first type of network to be discussed is the simple connection of a number of terminals to a computer, either directly or through multiplexors. Three different multiplexors are described by Clare, but the common feature is that they share the capacity of a single communications line between two or more data channels. For example four terminals might share a single phone line to a computer with the aid of multiplexors.

Coverage of more complex networks involving multiple computers is provided on abstract and practical levels. Ideas like message switching and packet switching, and the widely known seven-layer ISO network model are discussed, and the briefest of descriptions of two proprietary network protocols are given.

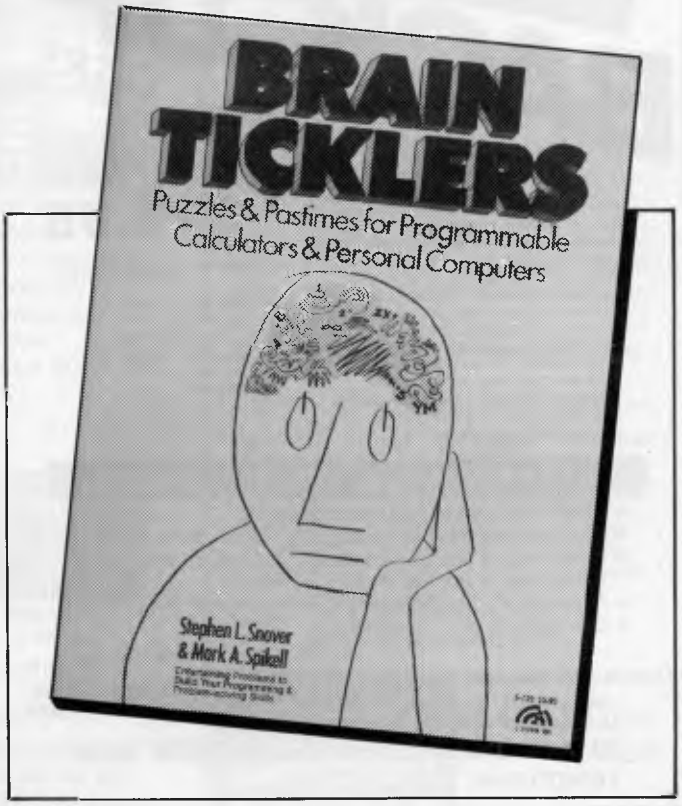
The penultimate chapter discusses the differences between local and wide area networks and is understandably the section of the book most closely tied to "real world" practice. Such networks as the US Government's ARPANET and the ALOHA radio system developed by the University of Hawaii represent the large scale networks, while the Cambridge Ring and Ethernet are taken as examples of the smaller end of the spectrum.

If you're looking for a grounding in this subject without going into any great detail, this is a reasonable choice.

Steve Withers

A Guide to Data Communications

Author: Chris Clare
Publisher: Castle House
Price: $20.95



Brain Ticklers

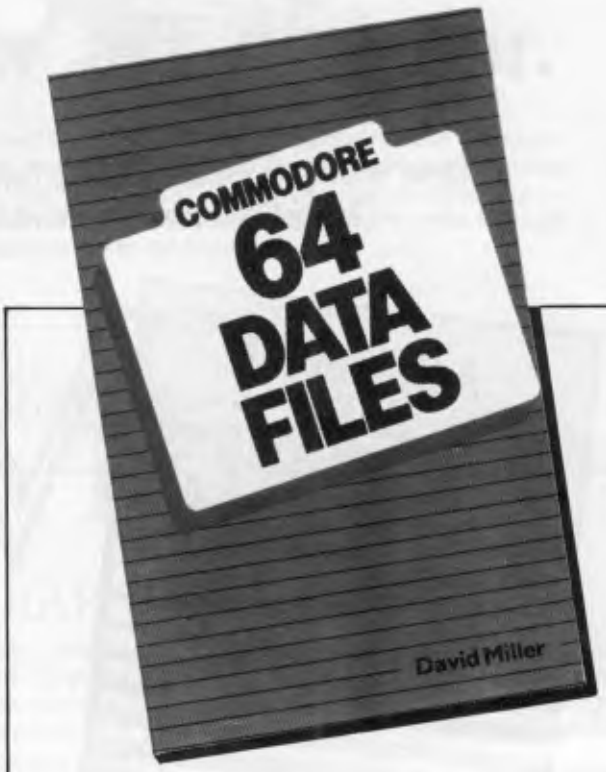
"Brain Ticklers" is the kind of book I expected when I opened "Brainteasers for the Commodore 64" (reviewed last month). Put simply, it consists of more than two dozen mathematical puzzles of the kind suitable for solution with the aid of a computer or programmable calculator. Some of the problems are best solved by analytical methods, while others call for a brute force approach. In addition to the puzzles themselves, the authors provide "hints" toward the solutions in the form of an algorithm along with an explanation of the method proposed. The model answers consist of Basic programs plus whatever numerical results they give. As a bonus there are usually several variations on each problem to stimulate further thought.

There's not much to be said about such a book — if you're interested in mathematical puzzles, you will probably find them entertaining provided that you haven't been programming for too long. Because the puzzles were chosen for solution with computers, experienced programmers are likely to find a method without very much thought. If I were teaching a mathematically inclined group to program, I would be very tempted to use some of these puzzles as exercises.

Steve Withers

Brain Ticklers

Authors: Stepehen L Snover and Mark A Spikell
Publisher: Prentice-Hall
Price: $9.25



Commodore 64 Data Files

The purpose of this book, says the author, is to take some of the misery and mystery out of learning to use the Commodore 64's file structure. The pity of it is, of course, that the misery and mystery are there in the first place. My rather jaundiced view of the Commodore 64 is, I'm afraid, that it's an ageing machine. On the whole I'd rather not age with it, struggling to understand its quirky ways.

Most of this book consists of lengthy listings which, mercifully, can be ordered from California on disk. Some are just for drill and practice, others provide a mailing list, a home inventory, a magazine catalogue or a simple medical records file. If you choose to enter them from the book, note the author's ridiculous warning that they were printed on a letter-quality machine which couldn't differentiate between number 1 and lowercase letter l, has slashless zero and no means of doing a proper up-arrow character.

Manipulating Commodore 64 files and creating your own programs are yours to discover with this book, says the blurb.

All yours, say I.

David Taylor

Commodore 64 Data Files

Author: David Miller
Publisher: Prentice-Hall
Price: $19.95

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THE QUESTIONS:

1 EDITING

Which kind of editing operation is quickest to execute and easiest on the eyes of the word processing user?

a) Full screen editing allowing for easy cursor movement around the screen?
b) Moving the cursor around by doing a line count?
c) Editing on the bottom line of text only?

2 DOCUMENT LAYOUT

You have created a document and want to see what the finished article will look like. Should you . . .

a) View it on the screen as it would come out of the printer?
b) Run it through a pre-processor to see what it looks like and then, if you like it, print it?

3 KEYSTROKES

Using a well designed wp system, how many keystrokes should it take to execute the most often used w-p functions?

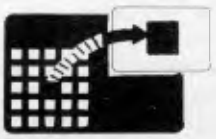
a) One easy stroke with no codes?
b) Two or more with complex w-p codes?
c) Three or more?

4 FLEXIBILITY

As the business manager of your company, you would like to find w-p software that you can tailor to your company's specific needs. Should you . . .

a) Look for w-p software that allows you to change and add menus, and change function keys?
b) Write your own custom software?

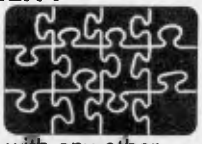
5 RETRIEVAL



If you want to retrieve information quickly from a large database, which w-p software should you choose?

a) One that can access a particular record by going to it directly?
b) One that searches through all the records on the database sequentially until it finds the right one?

6 COMPATABILITY



As a manager of MIS, you want a w-p system that can be integrated with any other compatable application software. Should you choose w-p software with . . .

a) ASCII formatted files?
b) Software which requires non-printing characters in its file system and/or specially formatted files.

7 MATH

Your company has a number of financial applications and is looking for a w-p package with math capabilities. Should you choose . . .

a) On screen calculating allowing for editing, storing and recall of equations, calculations integrated with your word processing applications?
b) Software where the math capabilities are tied to the list processing module?
c) A separate math package?

8 PORTABILITY

Should you choose

a) W/P — DBMS that runs on a wide range of CPUs from micros up to super-minis — in exactly the same way, with the same features and with your existing peripheral equipment.
b) W/P which runs on a limited number of micros only.

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Find the truth behind the words

Newcomers to computing are often baffled by bewildering jargon and incomprehensible advertising. Tony Westbrook offers a guide to some of the basic terms, and points out some frequent misunderstandings.

To a newcomer, it is a terrifying experience to go into a computer dealer's showroom or read advertisements only to be bombarded with bits and bytes, megahertz and memory — what does it all mean?

Computing has developed so fast that new words have become essential to describe all the concepts. Much the same thing has happened in the motor industry, but a car dealer who talks about 'big ends', or 'limited slip differentials' doesn't seem to provoke the same sort of rage.

Perhaps people are more tolerant of car industry jargon because they realise that what is important about a car is not its technical specifications but simpler attributes such as top speed, acceleration, size and fuel consumption. These points are what attract a driver's attention.

But of course the same is true of a business microcomputer. You don't need to be intimate with the internal architecture of your microprocessor to know that it does its job well. But an understanding of such matters and their effect on a machine's performance can help you understand what a computer can and can't do.

The *microprocessor* is often referred to as the heart of a microcomputer system. That's a fine definition if you have some idea of what it is in the first place, but for most the concept is confusing.

In the good old days, when computers were the size of a house, the processor was just one of the many boxes — usually the one with flashing lights on the outside. Nowadays, the microprocessor is just one tiny silicon chip inside the processor unit.

A common misconception concerns the addition of user memory — make sure your software will actually use it.

It is the only device able to perform calculations and act on data it receives. All the other parts of a computer behave in a pre-set way. What a microprocessor does depends entirely on the data — or software — it is using.

There are quite a few types of microprocessor about, so what is the difference between them? The major division, if the ads are to be believed, is between *8-bit* and *16-bit* devices. Since 16 is twice as big a 8, it's at least twice as good, they argue.

To an extent this is true. A bit represents one channel that can be used to move data around inside a computer. An 8-bit microprocessor has 8 channels — analogous to an 8-lane highway — and a 16-bit device twice as many, allowing twice as much data past in a given time.

But to continue that analogy — if the cars on the 16-lane highway are only travelling at half the speed of those on the 8-lane one, the number of cars passing a given spot will be the same in each case. The speed is measured in *megahertz* (MHz) and is determined by a clock inside the chip.

A typical 8-bit microprocessor might be the Zilog Z80. This is the chip which was used in the first standard business microcomputers. Early versions ran at about 4 MHz, but the latest models can reach twice that speed, equalling the capacity of slower 16-bit devices.

So the slowest 16-bit devices may have poorer performance than the best of the 8-bits, but a common 16-bit device like the Intel 8086 runs at about 6 MHz, so is still passing more data than a Z80 running flat out.

A lot of devices are a hybrid of 8-bit, 16-bit and even 32-bit data pathways. The Intel 8088, for instance, is a 16-bit microprocessor, but only talks to the outside world through 8 bits. The Motorola 68008 has 32-bit internal architecture and still only communicates through an 8-bit pathway (bus).

In practice, a microprocessor cannot work as fast as these calculations would suggest. The control of such a complex system requires a considerable amount of extra processing, leaving less processor time for your work.

It is much more important to consider what the implications of a particular microprocessor are for the software you want to run. Generally the devices run in families, with a high degree of compatibility. So the Intel range, from 8088 through 8086 to 80286, all run a similar type of software. Moving between machines using these microprocessors may be difficult, but at least possible — transferring software from a Z80 to a 68000 is more likely to fall into the

second category.

Most business micros use *floppy disks* as a way of storing the programs and data needed to operate them. The standard size is 5¼-inch, although a few micros still use the larger 8-inch ones. Almost certain to replace the 5¼-inch disk eventually is the 3½-inch micro disk. This is encased in hard plastic — rather like a cassette — and is much more robust. The problem so far with these small disks is getting sufficient storage capacity on a single disk.

Computer storage capacity, both in disks and memory, is measured in bytes. For business applications, a disk with less than about 200k bytes of storage is practically useless. Current technology will allow capacities of up to 1.2 Mbytes on standard and about 600k bytes on microfloppies.

Winchester disks are becoming quite common where a large amount of data has to be stored. There are hard disks mounted permanently into a drive. Because they never have to be removed, the manufacturing tolerances can be much closer, and the disk can be made to store much more data. A 5¼-inch Winchester disk might store 10 Mbytes of data on the same surface area as a removable floppy.

ROM and *RAM* sound like a comedy duo but are actually the two common memory types in a business machine. Read only memory (ROM) contains data which cannot be changed — it can only be read. It is used where software routines are always needed to control the micro. For example, a ROM tells a micro to load software from a floppy disk when you first switch on.

In some machines a ROM holding the basic programming language is fitted so that the micro can be programmed without the need for a mass-storage device like a disk drive. This is more common in home micros.

Random access memory (RAM) can be changed while the machine is on, but loses all data when switched off. It is the user memory. Programs loaded from disk, data generated by running the program and data representing the video

display are all stored here.

There is quite a common misconception that adding user memory is 'a good thing'. But how memory is used is entirely governed by the software you are running, so don't buy extra unless you are sure that your software will actually use it.

The amount of RAM a micro can have is governed by the processor used, since each processor is only capable of identifying a certain amount of memory. Many 8-bit processors cannot 'see' more than 64k bytes of RAM, and consequently a lot of software written for these systems only uses that much space. Some of these programs have subsequently been reconfigured for 16-bit micros, but their memory requirement remains the same.

Newer 16-bit machines have no serious memory limitations, except for those imposed by the cost of memory chips, and the time taken to find a particular spot in a large memory array. Software written more recently thus tends to need more memory, and the most sophisticated packages will use up any surplus memory that is left to improve their performance.

For applications where the user cannot afford to lose data held in RAM, but has no mass memory available — most usually a portable computer — there are two alternatives. The first is to design the micro so that even when the machine is switched off, a battery supplies enough current to keep the RAM activated. This is the most common method for portables because it is the cheapest. The other is to use 'bubble' memory. This is a type of RAM that even when switched off, stores the data last held in it. The disadvantage is its high cost — although predicted to fall in price, there has been no significant change so far.

Interfaces are the links that allow your micro to operate printers, plotters and other peripherals. They fall into two main types — parallel and serial.

Parallel interfaces are cheaper to produce on a computer because they move data in the same way as the computer. As we saw when looking at microprocessors, data is moved around inside a computer on several lines at once — usually eight. So most micros will have a parallel interface usually to drive a printer.

Serial interfaces are slightly more complicated to produce because they send the data down a single line, one bit after another. This requires a conversion from the normal parallal mode of a micro. They are ideally suited for use with a modem, for long-distance communication. On multi-user systems they are also usually the way of connecting extra users, each with a terminal, to the main system.

Software, although fundamentally more important than the hardware it runs on, is less prone to complex technical jargon. The major exception is operating systems, which usually manage to mystify everybody. This may be because they are quite closely linked to the microprocessor.

Operating systems are programs designed to run on a particular computer. The idea is that the operating system should contain standard commands relating to jobs like reading and writing to disks, keeping a record of what is stored on a disk, identifying and matching different printers and a host of other 'housekeeping' routines.

Applications software — like word processing, spreadsheets and accounting packages — can then use these standard commands, and so work on a variety of different machines. It's a great idea, and to a certain extent it has worked — particularly with CP/M for 8-bit machines, and MS-DOS for 16-bit systems. The problem is that in a competitive market manufacturers are not prepared to stick to the rules and start adding all kinds of extra keys and functions to their machines. The standard software doesn't recognise these so has to be altered to suit the micro — defeating the whole purpose of the exercise.

In a multi-user micro, the operating system is also responsible for looking after each user, and making sure that they don't try to write to the same file or record at the same time. No standard multi-user operating system has appeared, although IBM's choice of Xenix on its new AT micro will give Xenix a considerable advantage.

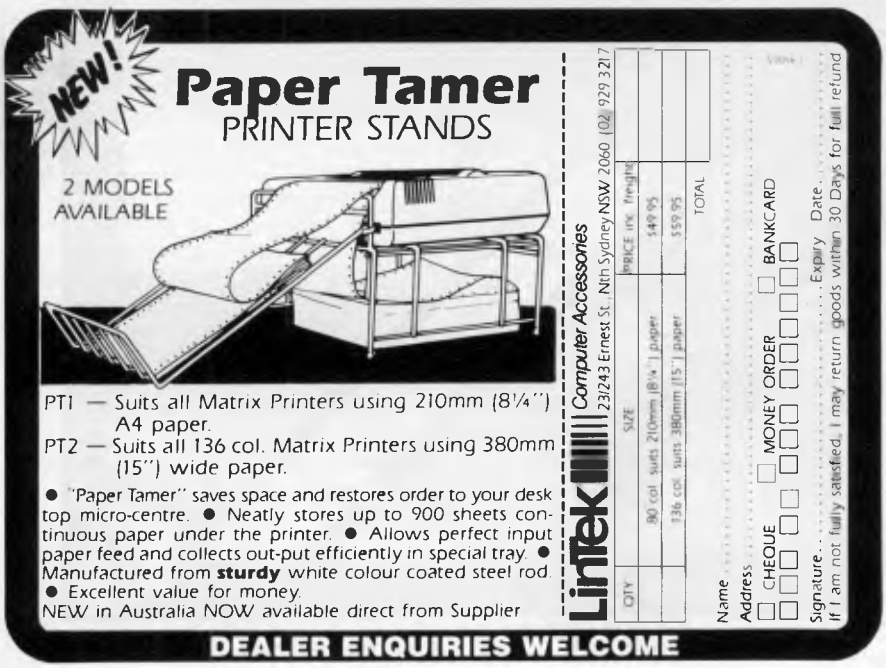
One phrase that is being used more and more is *'integrated' software*. Originally seen in accounting packages, it refers to the way software can be designed so that different functions of a package can share common data.

Integrated packages getting the most publicity at the moment are office management systems like Framework from Ashton Tate, and Symphony from Lotus Development Corporation. They combine several common microcomputer applications in one package, and let you move information around very easily. Both these examples have a word processor, spreadsheet, graphics, simple filing system (database) and communications. The integration would allow you, for example, to print information stored in a database using the word processor.

There has been a move on the part of the computer industry to try to concentrate on what a micro can do rather than how it is built. Many of the latest advertisements have removed jargon in favour of concepts — saying things like: 'look what you can do with your micro!' instead of 'look how many Mbytes it has got!'

Some of the newer dealer chains are also trying to appear more approachable to potential business users. It is a new attitude, and a development that can only be welcomed.

END



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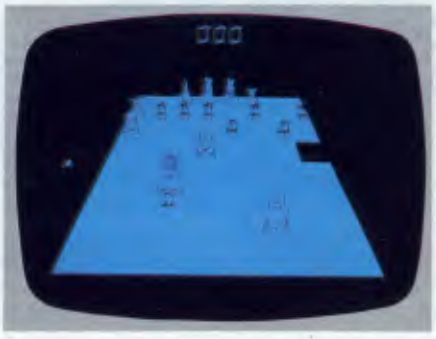
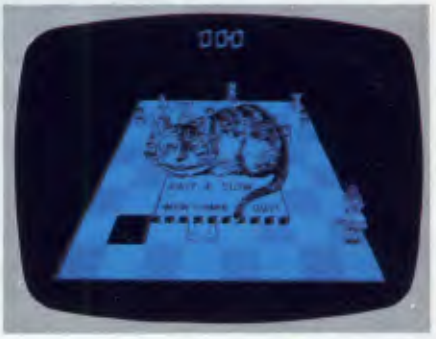
Tony Hetherington peers through Alice's Looking Glass, competes in the Great Space Race and takes revenge in the land of Doomdark, all in this month's Screenplay.





Wonderland chess

GAME: Alice Through the Looking Glass
MACHINE: Apple Macintosh
SUPPLIER: Apple
PRICE: Approx $60

Alice is the first games program I've seen for the Macintosh. It's a chess variant in which you play Alice against a Wonderland chess set.

You start the game by selecting the piece that you wish Alice to mimic. Most people will head straight for a queen but for a real challenge you should try one of the lesser pieces. To move your piece, you move a mouse-driven cursor to the required square and press. The game isn't played in set turns, so if you stop and think you'll be clobbered.

Luckily you are quickly resurrected and the action continues. The best strategy I have found is to click in several moves in advance, but you must have the mouse ready for when things go wrong. For example, avoid the hole that moves around the board swallowing pieces.

Your performance is rated by a score which is increased when pieces are taken, but points are deducted for a hammering. The theoretical maximum is 999 but to achieve this you must take all the opposing pieces, including the pawns once they have been promoted to queens, without being hit. But the prospect of nine queens is somewhat daunting.

Alice is an extremely professional, well presented game. Although the review copy was described as being pre-production, the game was supplied in mock book cover complete with velvet-like inlay and ribbon.

The great space hype

GAME: The Great Space Race
MACHINE: Commodore 64, 48k Spectrum
SUPPLIER: Top-of-the-Chart
PRICE: $22.50

The policy behind Screenplay is to review only the best games. However, *The Great Space Race* has been hyped so much that we had to look at it.

According to the hype, it was to feature movie-style graphics in a game that was to follow BMA award winner *Valhalla*.

Unfortunately the game falls sadly short of the hype, and the movie-style graphics are a nuisance: they interrupt the flow of the game.

You deal in a particular potent brew called Natof which is coveted throughout the galaxy. Unfortunately you can't deliver the stuff yourself, so you have to hire traders from a bunch of drunks, psychopaths and crooks. These characters are more likely to drink the stuff themselves than deliver it.

Your problems increase with the intervention of pirates and the galactic police who want their share, not to mention the other racers.

The fight sequences are particularly disappointing. They merely consist of drawings leaping unrealistically around the screen with the occasional line drawn between them. Also, the use of Basic makes the game slow.

The Great Space Race has an interesting plot, but is badly let down by its implementation.

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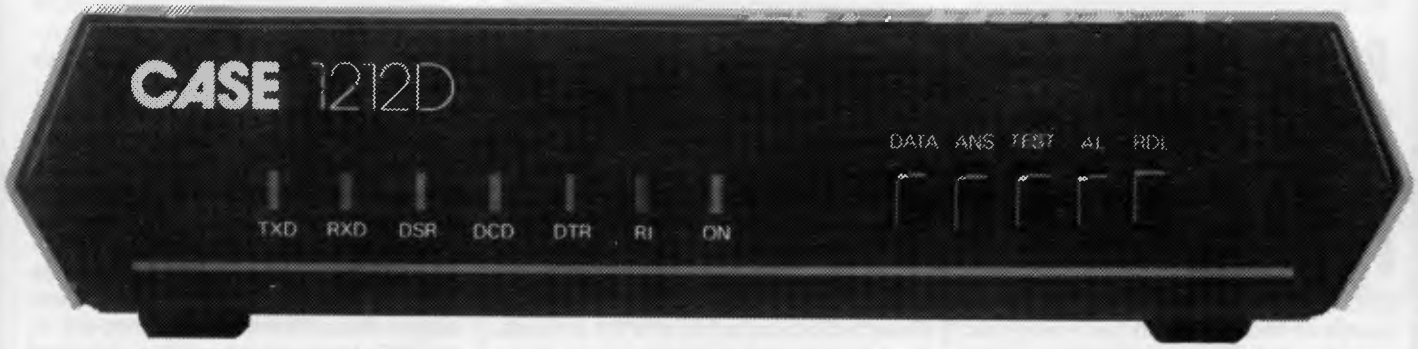

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AD 6495

Revenge is sweet

GAME: Doomdark's Revenge
MACHINE: 48k Spectrum
SUPPLIER: Top-of-the-Chart
PRICE: $27.50

Doomdark's Revenge is the sequel to *Lords of Midnight* and has a tough act to follow. But it has not only matched the depth of appeal of Midnight, it has actually improved on it.

Morkin, son of Luxor the Moonprince, has been kidnapped by Shareth, daughter of the Witchking of Doomdark. Your task is to journey into the frozen wastes of Icemark (which lies to the North of Doomdark) and rescue him.

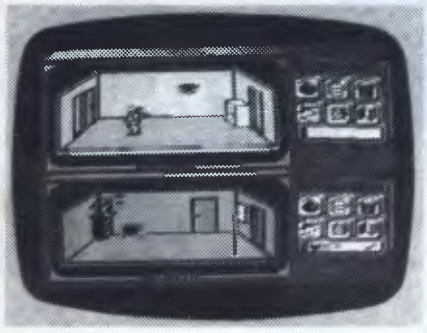
You have a number of characters with which to accomplish this: they are Luxor and Rorthon from Midnight, and Morkin's girlfriend Tarithel the Fey. You can also recruit help from the inhabitants of Icemark, but remember you're a stranger from Midnight and this may prove difficult.

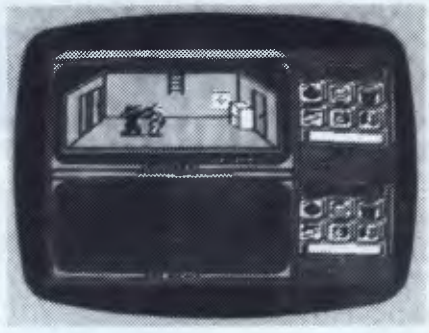
Icemark is divided into five kingdoms which are split by bitter rivalries, but Shareth the heartstealer is Queen overall. A total of 123 independent Lords command the forces of the races of Giants, Dwarfs, Barbicans, Fey and the Icelords. Each Lord has his own allegiances, hates and personal vendettas, and may be more interested in settling an old score than helping you. Similarly the Lords may be involved in their own quest to find one of the 128 treasures littered throughout Icemark. They may have even joined forces with Shareth and their welcome will certainly be hostile.

To defeat Shareth you'll need help from these Lords, so you should get to know their personalities and ambitions; perhaps you'll have to help them before they'll help you.

You'll also have to map out the land. The map printed on the back of the instruction booklet is at best vague, as the supplier considered that the map in Midnight made the game too easy. The company will sell you a mapping aid but this will be of little help. The problem isn't alleviated by the fact that Icemark is bigger than Midnight and consists of 48,000 'landscaped' screens. Some of the new landscapes feature palaces and temples, gates and pits, and magical fountains. The gates and pits allow access to torchlit underground passages which may provide safe passage under an enemy army, but may also harbour foul creatures.

Doomdark's Revenge is a mammoth challenge, even to those who successfully completed *Lords of Midnight*.





Tinker, tailor, micro, spy

GAME: Spy vs Spy
MACHINE: Commodore 64
SUPPLIER: ISD
PRICE: $29.95

Two famous adversaries from *Mad* magazine come to life in this classic game of skulduggery, as you try to outfox your enemy in an attempt to steal papers from an embassy.

Within a set time limit you must escape through a hidden door carrying a top secret briefcase which contains passport, money, key and, of course, the secret plans. These are all hidden throughout the embassy in cupboards and behind paintings, and must be found. Unfortunately you can only carry one object at a time, except if things are put in the briefcase.

This is only a minor problem when compared to the lengths to which your opponent will go to steal your ill-gotten gains. These range from bashing you with a club to more subtle traps involving bombs, large springs and buckets of water. Traps can be laid above doors or in the hiding places. Both spies contribute to this mindless violence which makes the embassy a very dangerous place, particularly since spies have been known to be blown up by their own bombs.

There are ways to avoid most of the traps: for example, an umbrella found in a coat rack will protect you from electrifying water, but it's too late to remember this if you're already fitted with a pair of wings and a halo. When this happens, your opponent pauses for a chuckle before continuing with his task.

A demised spy soon returns after losing vital seconds, but well-timed revenge will turn the tables.

The spy who collects all the items isn't

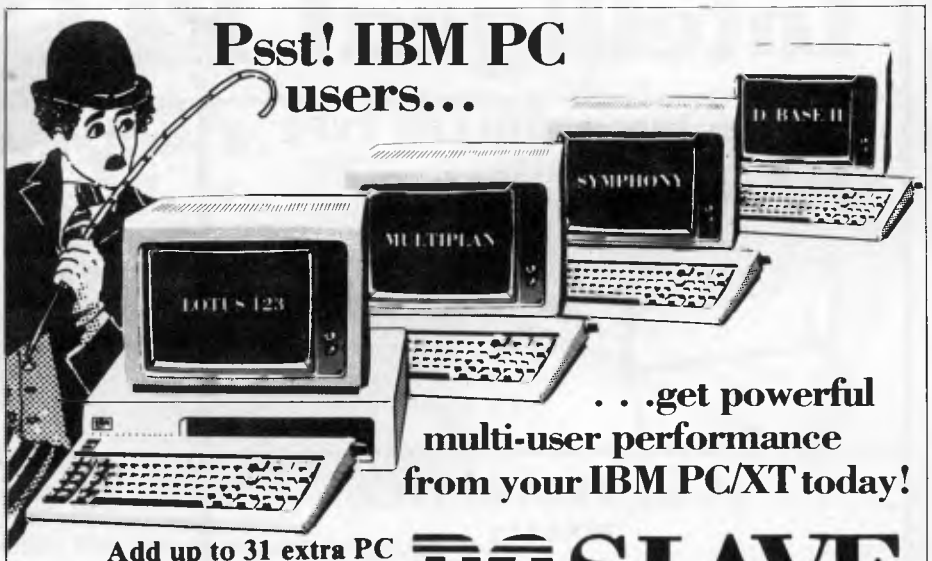
always the winner — a mugging could enable your enemy to steal the bag of goodies and make a run for his waiting plane. The winner is then rated on his performance and given an accolade ranging from 'knee high spy' up to 'good guy spy'.

You can compete against either a human or computer opponent in a variety of embassies: these can incorporate just six rooms, or be one building split into two levels complete with holes hidden under carpets.

The screen graphics greatly enhance this game. Each spy has his own display of the room he is in which is transferred to a single display when they enter the same room. To the right of the displays are trapulators, which are used to select the traps (with a joystick) or a map of the embassy.

The game has a soundtrack that will be whistled by the players long after the last bomb has exploded.

END



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Our unique Tulpi Intelligent Modem™ is designed and made in Australia for Australian conditions. Its microprocessor control, wide range of baud rates and protocols and superior Longline™ circuitry make it one of the most powerful modems on the market. It outperforms imported modems that sell for up to twice the price.

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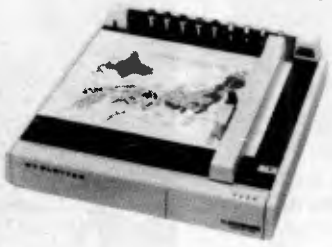
Intelligent PLOTTERS

A1 size, PINCH ROLLER TYPE
GP9101

★ 4 pens
★ 250mm/sec
★ Step size 0.05mm
★ With HP/GL option

It can be run under lotus 123 + Auto cad

A3 size, HIGH SPEED MULTIPEN
FP5301

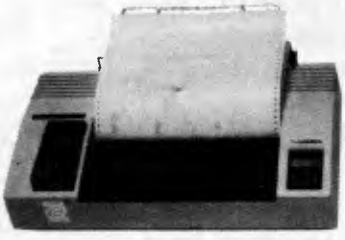


★ 10 pens
★ 450mm/sec
★ Step size 0.05mm
★ With HP/GL option

It can be run under lotus 123 + Auto cad

A3 size, PLOTWRITER
WX4731

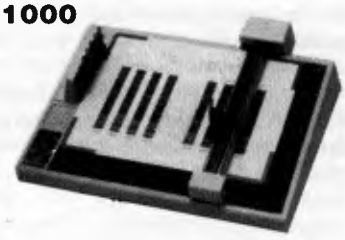
★ 4 pens
★ 200mm/sec
★ Step size 0.1mm
★ Up to 1m plot



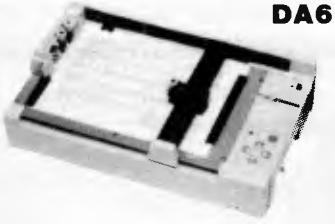
A3 size, MULTI FUNCTION, PORTABLE
MP1000

★ 6 pens
★ 150mm/sec
★ Step size 0.1mm
★ With HP/GL option

It can be run under lotus 123 + Auto cad



A4, COMPACT
DA6100

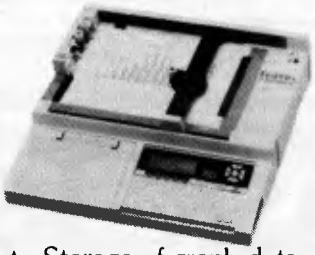


★ 3 pens
★ 200mm/sec
★ Step size 0.1mm
★ With HP/GL option

DA6100 with RS232 **$768** inc tax

8 Bit parallel **$732** inc tax

BUSI-PLOT
DA6500



★ 3 pens
★ 200mm/sec
★ Step size 0.1mm
★ Six types of graphs selectable
★ Easy programming using Basic Functions
★ Storage of graph data auto cassette type

DA6500 **$2136** inc tax

A4 SERVOPLOT
DA8400

★ 6 pens
★ 410mm/sec
★ Step size 0.1mm

A3 DIGITIZER
KD4030

★ Electro magnetic method
★ Resolution 0.1mm
★ Accuracy ± 0.5mm
★ 3 types of reading mode

Interfaces available for the above plotters are RS232, 8 Bit parallel and in most cases GPIB

Intelligent Plotter sale: WX4671 single pen **$600** inc tax.
WX4675 six pen **$660** inc tax. Limited numbers available.

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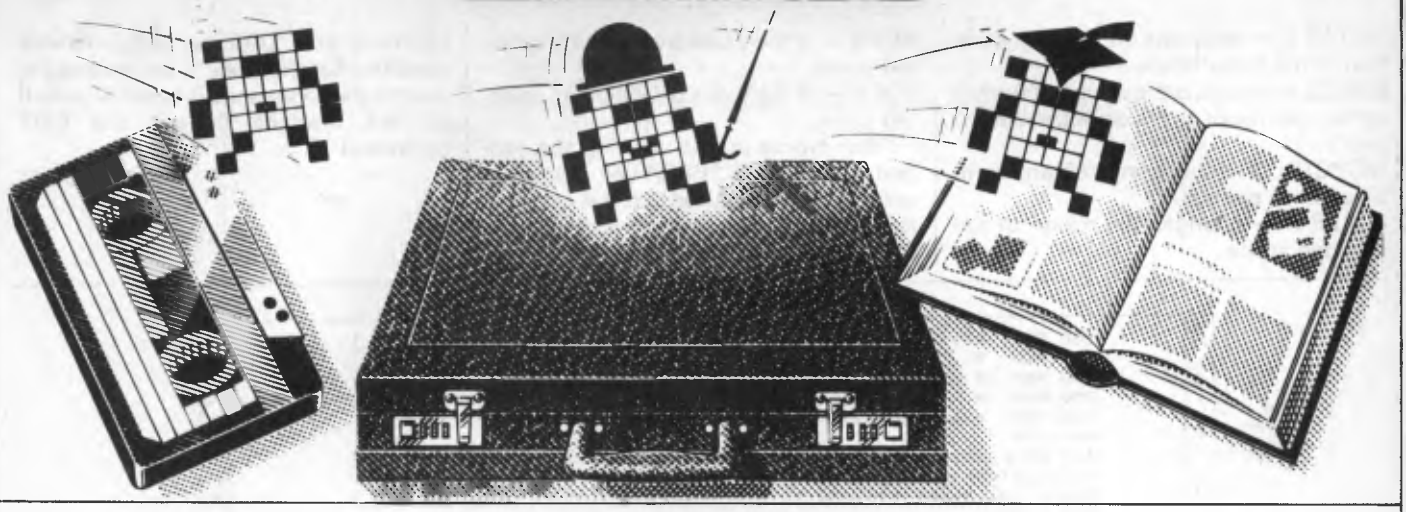
PROGRAMS



We select the best of readers' programs — for details on submitting your own, see the end of this section.

The most common objection to the Commodore 64 is its abysmal Basic — anything remotely clever ends up as an encrypted tangle of POKEs. The best program of the month turns the 64 into something usable, and gives a Basic programmer simple access to the sprites and music capabilities. In total 29 new commands are added to the Basic, all of which can be used in the normal way. As the program is in machine code, it can be POKEd in with the top of memory lower and the original Basic deleted. This way it occupies only a few hundred bytes, leaving plenty of room for a Basic program, and the commands operate faster than their equivalent POKEs.

BBC owners can produce professional smooth scrolling of text and graphics with the smooth scroll routine published this month. Text on a graphics screen has always been a problem for Atari owners, but is elegantly solved with the Multi-Mode Text program. Although short it's very powerful when offering text in any graphics screen, and features numerous other niceties.

Atari owners will find Multi-Mode Text a useful method for incorporating text onto graphics screens in any mode.

There's a nifty arcade-style game of superior quality for the TRS-80 Model I; and there's part two of the Commodore 64 listing Crazy Caverns.

Games
Scientific/mathematic
Business
Toolkit/utilities
Educational/Computer Aided Learning

Program of the Month
Commodore 64 Scroffs Basic

by David Gristwood

I like this program — not just because it's an excellent program that adds 29 new commands to Commodore Basic, but also because all the commands are fully described within the REM statements of the listing. Here's a brief description of the commands:

CLS — clears the screen.
PAPER X — changes the colour of the main screen(paper), X between 0 and 15.
EDGE X — changes the colour of the border, X between 0 and 15.
AT X,Y — is used in conjunction with PRINT to position text anywhere on the text screen.
JUMP X — calculated GOTO, jumps to the line number in X.
KEY — waits for any key to be pressed.
YNKEY — waits for either the Y or N keys to be pressed.
PAUSE X — pauses X seconds.
EXIT — switches off Scroffs Basic.
CFILL X — fills colour matrix and hence printed colour.
SFILL X — fills the screen with the ASCII character corresponding to X.
REPEAT . . . UNTIL (cond) — normal REPEAT UNTIL loop.
FPOP — allows GOTO exit from a FOR loop without confusing the next FOR loop.
GPOP — allows GOTO exit from a GOSUB without confusing the next GOSUB.
RVS — reverses everything on the screen.
VOL X — sets the volume and selects the type of filter for subsequent sound commands.
VX X — selects the voice (0 to 3) for subsequent sound commands.
ENVEL Attack, Decay, Sustain, Release — defines the envelope to apply to a voice.
MUSIC X — sounds the selected voice at frequency X, plays the note.
PULSE X — applies a pulse to the voice, X defines width of pulse.
PLAY X — POKEs the control register for current voice.
FILTFQ X — defines the cut-off frequency for a filter.

FILTER X — switches on any combination of the three filters.
SPRITE X — selects the sprite for further sprite commands to act on, X between 0 and 7.
MOBCTRL X — turns on or off any combination of sprites.
COLSP X — changes the colour of the selected sprite.
XSP X — is the x coordinate of the selected sprite.
YSP X — is the Y coordinate of the selected sprite.

After typing in and running the program, typing SYS 36864 will enable the extra to be used. After that it is possible to get rid of the program and use the commands for your own programs.

LOADing and SAVEing programs will not affect Scroffs Basic — the only way to disable the commands is to either switch off the machine or use the EXIT command.

Nick Walker

```
100 REM  ***************************
150 REM  *    SCROFF'S BASIC 1.0    *
200 REM  *   FOR THE COMMODORE 64   *
250 REM  *    BY DAVID GRISTWOOD    *
300 REM  ***************************
350 REM
400 POKE 55,0:POKE 56,144:CLR:REM RESERVE 4K OF MEMORY
450 CLST=9*4096+12*256:CZ=0
500 PLLST=9*4096+15*256:PHLST=PLLST+8*16:PZ=0
550 BL$="                                        "
1000 REM
1005 REM * INTRODUCTION *
1010 REM
1050 PRINT CHR$(8):PRINT CHR$(142):PRINT CHR$(147)
1100 PRINT TAB(8)"WELCOME TO SCROFF'S BASIC":PRINT
1150 PRINT"  WHEN RUN, THIS  PROGRAM ADDS 29 EXTRA"
1180 PRINT" COMMANDS  TO BASIC. THE 'REM'S IN THIS"
1200 PRINT" PROGRAM GIVE FULL DETAILS OF THESE NEW"
1240 PRINT" COMMANDS AND HOW TO USE THEM."
1260 PRINT:PRINT"     LOADING DATA NOW. PLEASE WAIT."
1280 GOTO 2000
1300 REM
1305 REM * DATA ERROR ROUTINE *
1310 REM
1315 REM PRINT ERROR MESSAGE THEN STOP
1320 PRINT:PRINT"?BAD DATA ERROR IN LINE";
1340 PRINT PEEK(63)+256*PEEK(64)
1360 END:GOTO 1360
1400 REM
1405 REM * LOADING SUBROUTINE *
1410 REM
1420 REM READS IN A HEX NUMBER OF LENGTH DG
1450 AZ=0:READ AZ$
1460 IF LEN(AZ$)<>DG THEN 1300
1470 IF AZ$="ZZ" OR AZ$="ZZZZ" THEN RETURN
1480 FOR T1=1 TO DG
1500 :TV$=MID$(AZ$,T1,1):TV=ASC(TV$)
1520 :IF (TV>47ANDTV<58) OR (TV>64ANDTV<71) THEN 1560
1540 :GOTO 1300
1560 :V=VAL(TV$):IF V<>0 OR TV$="0" THEN 1600
1580 :V=TV-55
1600 :AZ=AZ+(V*16^(DG-T1))
1640 NEXT T1
1680 RETURN
2000 REM
2005 REM * MAIN LOADING ROUTINE *
2010 REM
2040 REM READ STARTING ADDR OF ROUTINE
2050 DG=4:GOSUB 1400:IF AZ$="ZZZZ" THEN POKE CLST+CZ,0:END
2080 AZ=INT(AZ)-1:AH=INT(AZ/256):AL=AZ-(256*AH):ADDR=AZ+1
2100 POKE PLLST+PZ,AL:POKE PHLST+PZ,AH:PZ=PZ+1
2140 REM READ NAME OF ROUTINE
2160 READ NAME$:IF LEN(NAME$)<2 THEN 1300
2200 FOR I=1 TO LEN(NAME$)
2220 :NAME=ASC(MID$(NAME$,I,1)):IF NAME>64 AND NAME<91 THEN 2250
2240 :GOTO 1300
2250 :IF I=LEN(NAME$) THEN NAME=NAME+128
2260 :POKE CLST+CZ,NAME:CZ=CZ+1
2280 NEXT I
2400 PRINT CHR$(19):FOR I=1 TO 9:PRINT:NEXT I
2440 PRINT BL$:PRINT CHR$(145);"   ROUTINE: ";NAME$
2500 REM READ IN DATA FOR ROUTINE
2520 DG=2:GOSUB 1400
2540 IF AZ$="ZZ" THEN 2000:REM END OF ONE ROUTINE
2580 POKE ADDR,AZ:ADDR=ADDR+1
2600 GOTO 2500
2980 REM
2990 REM
3000 DATA 9000, WEDGE
3020 REM ****************************
3040 REM *          WEDGE           *
3060 REM ****************************
3080 REM THIS IS NOT A  NEW COMMAND FOR
```

```
3100 REM BASIC.THIS IS THE MACHINE CODE
3110 REM ROUTINE  THAT LINKS  THE EXTRA
3120 REM COMMANDS TO BASIC.IT IS CALLED
3140 REM BY A 'SYS' CALL:
3150 REM          SYS 9*4096
3160 REM  OR
3165 REM          SYS 36864
3180 REM THIS  MUST BE USED  BEFORE ANY
3200 REM OF  THE NEW COMMANDS WILL WORK.
3240 REM
3260 DATA A9,50,8D,08,03,A9,90,8D
3280 DATA 09,03,A9,30,A0,90,20,1E
3300 DATA AB,60,A9,E4,8D,08,03,A9
3320 DATA A7,8D,09,03,60,3E,FC,FF
3340 DATA 00,50,8D,08,06,C5,AE,00
3360 DATA 00,03,A9,36,A0,9F,CE,00
3380 DATA 28,43,29,20,44,41,56,49
3400 DATA 44,20,47,52,49,53,54,57
3420 DATA 4F,4F,44,20,31,39,38,34
3440 DATA 00,58,ED,8C,72,D4,2B,FF
3460 DATA 20,73,00,20,59,90,4C,AE
3480 DATA A7,D0,03,4C,2B,A8,E9,80
3500 DATA 90,03,4C,F3,A7,A5,7A,48
3520 DATA A5,7B,48,A2,00,A0,00,B1
3540 DATA 7A,C9,41,B0,03,4C,89,90
3560 DATA C9,5B,B0,F9,9D,ED,90,E8
3580 DATA E6,7A,D0,02,E6,7B,4C,6F
3600 DATA 90,A9,00,9D,ED,90,AA,A8
3620 DATA BD,B1,02,B9,ED,90,DD,00
3640 DATA 9C,D0,04,C8,4C,C3,90,BD
3660 DATA 00,9C,C9,80,90,10,BD,00
3680 DATA 9C,38,E9,80,D9,ED,90,F0
3700 DATA 26,A0,00,4C,C3,90,A0,00
3720 DATA E8,BD,00,9C,C9,80,90,F8
3740 DATA EE,B1,02,E8,BD,00,9C,C9
3760 DATA 00,F0,03,4C,93,90,68,85
3780 DATA 7B,68,85,7A,4C,A5,A9,C8
3800 DATA B9,ED,90,C9,00,D0,EF,68
3820 DATA 68,AC,B1,02,B9,80,9F,48
3840 DATA B9,00,9F,48,60,43,46,49
3860 DATA 4C,4C,00,20,13,10,01,03
3880 DATA ZZ
3890 REM
4000 REM  THE FOLLOWING DATA IS FOR THE
4020 REM EXTRA BASIC COMMANDS.WITH EACH
4040 REM IS A  COMPLETE  DESCRIPTION OF
4060 REM WHAT EACH COMMAND DOES, HOW TO
4080 REM USE  IT, WHICH PARAMETERS  ARE
4100 REM REQUIRED  AND EXAMPLES  OF HOW
4120 REM THEY  MIGHT  BE  USED  IN  A
4140 REM PROGRAM.
4160 REM  THE DATA  STATEMENTS  CONTAIN
4180 REM THE MACHINE  CODE INSTRUCTIONS
4200 REM IN  HEX (BASE 16).
4260 REM THE FORMAT OF THIS PROGRAM HAS
4280 REM BEEN  DESIGNED  SO  THAT  NEW
4300 REM COMMANDS CAN  EASILY BE ADDED.
4350 REM WARNING - DO NOT USE LOCATIONS
4360 REM $02A0-$02B5 (TEMP. WORK SPACE)
4390 REM
4400 DATA 9100, CLS
4420 REM ******************************
4440 REM *          CLS               *
4460 REM ******************************
4480 REM CLEAR SCREEN.IT IS THE SAME AS
4510 REM          PRINT CHR$(147)
4520 REM BUT IS  EASIER TO READ  AND TO
4540 REM REMEMBER.THIS COMMAND COMBINED
4560 REM WITH THE  'AT'  FUNCTION, WILL
4580 REM SAVE MEMORY & MAKE HARD COPIES
4600 REM OF PROGRAMS EASIER TO READ.
4620 REM IT REQUIRES NO PARAMETERS.E.G.
4640 REM          10 CLS:PRINT A$
4650 REM
4680 DATA A9,93,20,47,AB,60
4730 DATA ZZ
4740 REM
4800 DATA 9110, PAPER
4820 REM ******************************
4840 REM *          PAPER             *
4860 REM ******************************
4880 REM  CHANGES THE BACKGROUND COLOUR
4900 REM OF THE  SCREEN  (THE 'PAPER').
4920 REM IT REQUIRES ONE PARAMETER, AND
4940 REM THE COMMAND TAKES THE FORM:
4960 REM              PAPER X
4980 REM WHERE X IS ANY  INTEGER IN THE
5000 REM RANGE 0 TO 15. THE NUMBERS ARE
```

```
5020 REM THE  STANDARD  ONES  FOR  EACH
5040 REM COLOUR  I.E.
5060 REM        0=BLACK    1=WHITE
5080 REM        2=RED         ETC
5100 REM IF A NUMBER  HIGHER THAN 15 IS
5120 REM IS USED, ONLY THE LOWER NIBBLE
5140 REM WILL  COUNT . THIS  COMMAND .IS
5160 REM THE EQUIVALENT OF
5180 REM           POKE 53281,X
5200 REM EG       10PAPER 0:CLS
5220 REM
5240 DATA 20,8A,AD,20,F7,B7,A5,14
5260 DATA 8D,21,D0,60
5340 DATA ZZ
5350 REM
5400 DATA 9120, EDGE
5420 REM ****************************
5440 REM *           EDGE           *
5460 REM ****************************
5480 REM  CHANGES  THE  COLOUR  OF  THE
5500 REM BORDER OF THE SCREEN ('EDGE').
5520 REM IT REQUIRES ONE PARAMETER, AND
5540 REM THE COMMAND TAKES THE FORM:
5560 REM              EDGE X
5580 REM WHERE X IS ANY  INTEGER IN THE
5600 REM RANGE 0 TO 15. THE NUMBERS ARE
5620 REM THE  STANDARD  ONES  FOR  EACH
5640 REM COLOUR  I.E.
5660 REM        0=BLACK    1=WHITE
5680 REM        2=RED         ETC
5700 REM IF A NUMBER  HIGHER THAN 15 IS
5720 REM IS USED, ONLY THE LOWER NIBBLE
5740 REM WILL  COUNT . THIS  COMMAND IS
5760 REM THE EQUIVALENT OF
5780 REM           POKE 53280,X
5790 REM 'EDGE' IS OFTEN USED  WITH THE
5795 REM 'PAPER' COMMAND  E.G.
5800 REM     10 PAPER 0:EDGE 0:CLS
5820 REM
5840 DATA 20,8A,AD,20,F7,B7,A5,14
5860 DATA 8D,20,D0,60
5940 DATA ZZ
5980 REM
6000 DATA 9130, AT
6020 REM ****************************
6040 REM *            AT            *
6060 REM ****************************
6080 REM  USED WITH  THE PRINT OR INPUT
6100 REM STATEMENT TO FORMAT THE SCREEN
6120 REM IT REQUIRES TWO PARAMETERS AND
6140 REM THE COMMAND TAKES THE FORM:
6160 REM              AT X,Y
6180 REM WHERE X IS THE X COORDINATE OF
6200 REM THE SCREEN (0 TO 39) ,AND Y IS
6220 REM THE Y COORDINATE (0 TO 24).THE
6240 REM POINT  0,0  IS IN THE TOP LEFT
6260 REM HAND CORNER.NOTE : NO CHECK IS
6280 REM THAT X  AND  Y ARE  IN  RANGE.
6300 REM WITH 'AT' ,FEW CURSOR CONTROLS
6320 REM WITHIN  PRINT STATEMENTS  NEED
6340 REM BE USED.  E.G.
6360 REM     10 CLS
6380 REM     20 AT 15,2:PRINT'DEMO'
6390 REM     30 AT 10,5:INPUT A$
6395 REM
6400 DATA 20,8A,AD,20,F7,B7,98,48
6420 DATA 20,F0,AE,20,8A,AD,20,F7
6440 DATA B7,A6,14,68,A8,18,20,F0
6460 DATA FF,60
6660 DATA ZZ
6670 REM
6700 DATA 9150, JUMP
6720 REM ****************************
6740 REM *           JUMP           *
6760 REM ****************************
6780 REM  A CALCULATED 'GOTO'.   I.E. A
6800 REM VARIABLE OR  EXPRESSION CAN BE
6820 REM USED FOR THE LINE TO BE JUMPED
6840 REM TO.    IN NORMAL CBM BASIC
6860 REM           10 GOTO X
6880 REM WILL GIVE AN ERROR. BUT 'JUMP'
6900 REM ACCEPTS  ANY  EXPRESSION  AS A
6920 REM PARAMETER.  E.G
6940 REM           10 X=25
6960 REM           20 JUMP X*2
6980 REM WILL  GOTO  ('JUMP')  LINE 50.
6990 REM
7000 DATA 20,8A,AD,20,F7,B7,4C,A3
7020 DATA A8
```

```
7060 DATA ZZ
7090 REM
7100 DATA 9160, KEY
7120 REM ******************************
7140 REM *            KEY               *
7160 REM ******************************
7180 REM WAITS FOR A KEY TO BE PRESSED.
7200 REM IT DISABLES THE 'RUN STOP' KEY
7220 REM & EMPTIES THE KEYBOARD BUFFER.
7240 REM IT WILL NOT ACCEPT 'SHIFT' AND
7260 REM 'CBM' ETC KEYS AS VALID.  E.G.
7280 REM 10PRINT'HIT A KEY TO CONTINUE'
7300 REM 20KEY
7320 REM TO FIND WHICH KEY WAS PRESSED,
7340 REM FOLLOW 'KEY' WITH A 'GET' E.G.
7360 REM       10 KEY:GET A$
7390 REM
7400 DATA A9,00,8D,C6,00,A5,C5,C9
7420 DATA 40,F0,FA,60
7480 DATA ZZ
7490 REM
7500 DATA 9170, YNKEY
7520 REM ******************************
7540 REM *           YNKEY              *
7560 REM ******************************
7580 REM SIMILAR TO 'KEY' BUT WILL WAIT
7600 REM UNTIL THE 'Y'  OR THE  'N' KEY
7620 REM IS PRESSED. IDEAL FOR A PROMPT
7640 REM WHICH REQUIRES ONLY A  YES  OR
7660 REM NO  ANSWER. USE THE  'GET'  TO
7680 REM FIND WHICH KEY IT WAS.  E.G.
7700 REM  10 PRINT'PLAY AGAIN (Y/N)?'
7720 REM  20 YNKEY: GET A$
7740 REM  30 IF A$='N' THEN END
7760 REM  40 REM PLAY GAME AGAIN
7790 REM
7800 DATA A9,00,85,C6,A5,C5,C9,40
7820 DATA F0,FA,C9,27,F0,07,C9,19
7840 DATA F0,03,4C,74,91,60
7970 DATA ZZ
7980 REM
8000 DATA 9190, PAUSE
8020 REM ******************************
8040 REM *           PAUSE              *
8060 REM ******************************
8080 REM WAITS  ('PAUSES')  FOR  A  SET
8100 REM TIME. THIS  DELAY IS THE VALUE
8120 REM OF THE EXPRESSION  IN SECONDS.
8140 REM THUS  IT  REQUIRES  ONLY  ONE
8160 REM PARAMETER.     E.G.
8180 REM          10 PAUSE 5
8200 REM WAITS FOR FIVE SECONDS  BEFORE
8220 REM THE  PROGRAM  CONTINUES.   THE
8240 REM EXPRESSION IS  EVALUATED AS AN
8260 REM INTEGER. NOTE : THE 'RUN STOP'
8280 REM KEY IS DISABLED  AND THE VALUE
8300 REM OF TI AND TI$ WILL BE ALTERED.
8320 REM
8340 DATA 20,BA,AD,20,F7,B7,A5,14
8360 DATA F0,0E,A9,00,85,A2,A5,A2
8380 DATA C9,3C,D0,FA,C6,14,D0,F2
8400 DATA 60
8550 DATA ZZ
8560 REM
8600 DATA 91B0, EXIT
8620 REM ******************************
8640 REM *            EXIT              *
8660 REM ******************************
8680 REM SWITCHES OFF SCROFF'S BASIC.IT
8700 REM REQUIRES NO PARAMETERS, AND IS
8720 REM NORMALLY USED IN DIRECT MODE :
8740 REM E.G.          EXIT
8760 REM IF ALTERING  SCROFF'S BASIC AT
8780 REM ALL, USE THE  'EXIT' COMMMAND.
8800 REM            SYS 36882
8820 REM CAN BE USED INSTEAD OF 'EXIT'.
8840 REM
8860 DATA 4C,12,90
8870 DATA ZZ
8880 REM
8900 DATA 91C0, CFILL
8920 REM ******************************
8940 REM *           CFILL              *
8960 REM ******************************
8980 REM COLOUR FILL - FILLS THE COLOUR
9000 REM MATRIX,  WHERE THE COLOURS  OF
9020 REM EACH SQUARE  ARE STORED,  WITH
9040 REM THE  VALUE  OF  'CFILL'S  ONLY
```

```
9060 REM PARAMETER.  THE  NORMAL COLOUR
9080 REM CODE APPLIES.      E.G
9100 REM        10 CFILL 0
9120 REM WILL CHANGE EVERYTHING PRINTED
9140 REM ON   THE   SCREEN   TO  BLACK.
9150 REM
9160 DATA 20,8A,AD,20,F7,B7,A9,00
9170 DATA 85,FB,A9,D8,85,FC,A0,00
9180 DATA A5,14,91,FB,C8,D0,FB,E6
9200 DATA FC,A5,FC,C9,DC,D0,EF,60
9460 DATA ZZ
9480 REM
9500 DATA 91F0, SFILL
9520 REM ****************************
9540 REM *          SFILL           *
9560 REM ****************************
9580 REM SCREEN FILL - FILLS THE SCREEN
9600 REM WITH  A  PARTICULAR  GRAPHIC
9620 REM SYMBOL ,  DETERMINED  BY  IT'S
9640 REM PARAMETER, WHICH  SHOULD BE IN
9660 REM THE RANGE 0 TO 255.THE CODE IS
9680 REM THE 'POKE' CODE  I.E.
9700 REM      0=@   1=A   33=!
9720 REM     49=1   58=:   ETC.
9740 REM THE SCREEN *MUST* BE AT 1024!!
9750 REM
9760 DATA 20,8A,AD,20,F7,B7,A9,00
9770 DATA 85,FB,A9,04,85,FC,A0,00
9780 DATA A5,14,91,FB,C8,D0,FB,E6
9800 DATA FC,A5,FC,C9,08,D0,EF,60
9860 DATA ZZ
9880 REM
10000 DATA 9220, REPEAT
10020 REM ****************************
10040 REM *          REPEAT          *
10060 REM ****************************
10080 REM  PART OF A 'REPEAT'...'UNTIL'
10100 REM LOOP. IT IS AN ALTERNATIVE TO
10120 REM THE 'FOR'....'NEXT' LOOP WHEN
10140 REM THE NUMBER OF  TIMES THE LOOP
10160 REM MUST  BE REPEATED IS UNKNOWN.
10180 REM IT REQUIRES NO PARAMETERS BUT
10200 REM *MUST*  BE THE FIRST  COMMAND
10220 REM ON THE LINE.
10240 REM
10260 DATA 68,68,A9,03,20,F8,A3,38
10280 DATA A5,7A,E9,0B,48,A5,7B,E9
10300 DATA 00,48,A5,3A,48,A5,39,48
10320 DATA A9,CC,48,4C,56,90
10340 DATA ZZ
10360 REM
10400 DATA 9250, UNTIL
10420 REM ****************************
10440 REM *          UNTIL           *
10460 REM ****************************
10480 REM  PART OF A 'REPEAT'...'UNTIL'
10500 REM LOOP. THE FOLLOWING PARAMETER
10520 REM IS  EVALUATED.  IF  FALSE  THE
10540 REM PROGRAM FLOW  RETURNS TO  THE
10560 REM LAST 'REPEAT' COMMAND.IF TRUE
10580 REM THE   PROGRAM  FLOW  IS   NOT
10600 REM AFFECTED   AND  THE   PROGRAM
10620 REM CONTINUES AS NORMAL. 'REPEAT'
10640 REM .'UNTIL' LOOPS MAY BE NESTED.
10660 REM AN E.G.
10680 REM        10 A=1
10700 REM        20 REPEAT
10720 REM        30 :PRINT A:A=A+1
10740 REM        40 UNTIL A=11
10760 REM
10780 DATA 68,68,68,C9,CC,D0,F8,20
10800 DATA 9E,AD,A5,61,F0,07,68,68
10820 DATA 68,68,4C,56,90,68,85,39
10840 DATA 68,85,3A,68,85,7B,68,85
10860 DATA 7A,4C,56,90
10880 DATA ZZ
10890 REM
11000 DATA 9290, FPOP
11020 REM ****************************
11040 REM *          FPOP            *
11060 REM ****************************
11080 REM  POPS THE LAST 'FOR' LOOP OFF
11100 REM THE STACK. NORMALLY  IF THERE
11120 REM IS A JUMP OUT OF A 'FOR'.....
11140 REM ..'NEXT' LOOP, INFORMATION IS
11180 REM LEFT ON THE STACK,AND IF THIS
11200 REM HAPPENS OFTEN,NO ROOM IS LEFT
11220 REM ON  THE STACK, SO  AN 'OUT OF
11240 REM MEMORY ERROR' OCCURS. CALLING
```

```
11260 REM 'FPOP'   *IMMEDIATELY*  AFTER
11280 REM LEAVING THE LOOP, SOLVES THIS
11300 REM PROBLEM.    E.G.
11320 REM    100 FOR T=1 TO 50
11340 REM    110 ::IF X(T)=NM THEN 130
11350 REM    120 NEXT T
11360 REM    130 FPOP
11380 REM    140 REST OF PROGRAM
11400 REM
11420 DATA 68,68,68,C9,81,D0,FB,A2
11440 DATA 11,68,CA,D0,FC,4C,56,90
11460 DATA ZZ
11480 REM
11500 DATA 9280, GPOP
11520 REM ****************************
11540 REM *          GPOP            *
11560 REM ****************************
11580 REM POPS THE LAST 'GOSUB' OFF THE
11600 REM STACK. SEE 'FPOP' FOR SIMILAR
11620 REM PROBLEMS WITH STACK. USED  IF
11640 REM YOU DON'T WISH TO RETURN FROM
11660 REM A  GOSUB. DO NOT  USE  IN THE
11680 REM MIDDLE OF A 'FOR'.'NEXT' LOOP
11700 REM OR A 'REPEAT'...'UNTIL' LOOP.
11720 REM
11740 DATA 68,68,68,C9,8D,D0,FB,A2
11760 DATA 06,68,CA,D0,FC,4C,56,90
11780 DATA ZZ
11790 REM
11800 DATA 92D0, RVS
11820 REM ****************************
11840 REM *          RVS             *
11860 REM ****************************
11880 REM  REVERSES THE FIELD OF  EVERY
11900 REM CHARACTER ON THE SCREEN. I.E.
11920 REM NORMAL GOES TO REVERSE FIELD,
11940 REM AND REVERSE GOES TO NORMAL.IT
11960 REM REQUIRES NO PARAMETERS.  E.G.
11980 REM           10 RVS
12000 REM SCREEN  *MUST*  BE  AT 1024!!
12020 REM
12040 DATA A9,00,85,FB,A9,04,85,FC
12060 DATA A0,00,B1,FB,49,80,91,FB
12080 DATA C8,D0,F7,E6,FC,A5,FC,C9
12100 DATA 08,D0,ED,60
12120 DATA ZZ
12140 REM
12200 DATA 9300, VOL
12220 REM ****************************
12240 REM *          VOL             *
12260 REM ****************************
12280 REM  REQUIRES ONE PARAMETER - THE
12300 REM VOLUME  FOR ALL THREE  VOICES
12320 REM OF THE SID CHIP. IF NOT USING
12340 REM FILTERS, PARAMETER  SHOULD BE
12360 REM IN RANGE 0(OFF) TO 15(MAX).EG
12380 REM          10 VOL 15
12400 REM IF USING FILTERS  SEE SECTION
12420 REM ON FILTERS, AND ADD FOLLOWING
12440 REM VALUES TO VOL:
12460 REM     +16  LOW-PASS FILTER ON
12480 REM     +32  BANDPASS FILTER ON
12500 REM     +64  HIGH-PASS FILTER ON
12520 REM     +128 VOICE 3 DISCONNECTED
12540 REM     +80  NOTCH FILTER ON
12560 REM E.G.     10 VOL 15+16
12580 REM IS VOL 15 AND LOW-PASS FILTER
12600 REM
12620 DATA 20,8A,AD,20,F7,B7,A5,14
12640 DATA 8D,18,D4,60
12660 DATA ZZ
12680 REM
12700 DATA 9320, VX
12720 REM ****************************
12740 REM *          VX              *
12760 REM ****************************
12780 REM  REQUIRES ONE PARAMETER - THE
12800 REM VOICE  FOR  THE  OTHER  MUSIC
12820 REM COMMANDS.I.E. 'ENVEL','MUSIC'
12840 REM 'PULSE' & 'PLAY'.THESE ACT ON
12860 REM THE MOST RECENT VOICE DEFINED
12880 REM WITH THE 'VX'  COMMAND. USE A
12900 REM LOOP FOR DEFINING ETC ALL THE
12920 REM VOICES. E.G.
12940 REM  10 FOR I=1 TO 3: VX I
12960 REM  20 REM OTHER MUSIC COMMANDS
12980 REM  30 NEXT I
12990 REM THE MOST RECENT  'VX'  IS THE
12995 REM CURRENT VOICE DEFINED.
```

```
13000 REM
13020 DATA 20,8A,AD,20,F7,B7,A9,00
13040 DATA 8D,B0,02,A5,14,C9,02,D0
13060 DATA 06,A9,07,8D,B0,02,60,C9
13080 DATA 03,D0,05,A9,0E,8D,B0,02
13090 DATA 60
13100 DATA ZZ
13120 REM
13200 DATA 9350, ENVEL
13220 REM ****************************
13240 REM *          ENVEL           *
13260 REM ****************************
13280 REM  REQUIRES FOUR PARAMETERS-THE
13300 REM ATTACK,DECAY,SUSTAIN, RELEASE
13320 REM IN THE RANGE 0  TO  15 (MAX),
13340 REM FOR THE LAST DEFINED 'VX'. EG
13360 REM        10 VX 1
13380 REM        20 ENVEL 0,7,4,2
13400 REM DEFINES THE WAVEFORM OF VOICE
13420 REM ONE (A=0, D=7, S=4, R=2).
13430 REM
13440 DATA 20,8A,AD,20,F7,B7,A5,14
13460 DATA 0A,0A,0A,0A,8D,A7,02,20
13480 DATA FD,AE,20,8A,AD,20,F7::
13500 DATA B7,A5,14,29,0F,0D,A7,02
13520 DATA AC,B0,02,C8,C8,C8,C8,C8
13540 DATA 99,00,D4,C8,8C,A8,02,20
13560 DATA FD,AE,20,8A,AD,20,F7,B7
13580 DATA A5,14,0A,0A,0A,0A,8D,A7
13600 DATA 02,20,FD,AE,20,8A,AD,20
13620 DATA F7,B7,A5,14,29,0F,0D,A7
13640 DATA 02,AC,A8,02,99,00,D4,60
13660 DATA ZZ
13680 REM
13700 DATA 93B0, MUSIC
13720 REM ****************************
13740 REM *          MUSIC           *
13760 REM ****************************
13780 REM  REQUIRES ONE PARAMETER - THE
13800 REM FREQUENCY ( OR NOTE ) FOR THE
13820 REM LAST 'VX' TO BE PLAYED.  MUST
13840 REM BE IN RANGE 0 TO 65535.  E.G.
13860 REM        10 MUSIC 4000
13880 REM
13900 DATA 20,8A,AD,20,F7,B7,AC,B0
13920 DATA 02,A5,14,99,00,D4,C8,A5
13940 DATA 15,99,00,D4,60
13960 DATA ZZ
13980 REM
14000 DATA 93D0, PULSE
14020 REM ****************************
14040 REM *          PULSE           *
14060 REM ****************************
14080 REM  REQUIRES ONE PARAMETER - THE
14100 REM WIDTH  OF  THE  PULSE, *IF* A
14120 REM SQUARE WAVE IS TO BE SELECTED
14130 REM (OF MOST RECENT 'VX' COMMAND)
14140 REM MUST BE IN RANGE  0  TO  4095
14160 REM (0 OR 4095  PRODUCE  CONSTANT
14180 REM OUTPUT,2048 PRODUCES A SQUARE
14200 REM WAVE.) E.G.
14220 REM         20 PULSE 2000
14240 REM
14260 DATA 20,8A,AD,20,F7,B7,AC,B0
14280 DATA 02,C8,C8,A5,14,99,00,D4
14300 DATA C8,A5,15,99,00,D4,60
14320 DATA ZZ
14360 REM
14400 DATA 93F0, PLAY
14420 REM ****************************
14440 REM *          PLAY            *
14460 REM ****************************
14480 REM  REQUIRES ONE PARAMETER - THE
14500 REM WAVE FORM OF THE CURRENT 'VX'
14520 REM       129  NOISE
14530 REM        65  PULSE
14540 REM        33  TRIANGLE
14560 REM        17  SAW TOOTH
14580 REM SHOULD  'PLAY 0'  BEFORE  THE
14600 REM NEW'PLAY'COMMAND.'PLAY' POKES
14620 REM INTO THE CONTROL REG. FOR THE
14640 REM CURRENT VOICE,SO OTHER VALUES
14660 REM CAN BE USED FOR RING MOD ETC.
14680 REM TO PLAY A COMPLETE VOICE :
14700 REM     10 VOL 15:VX 1
14720 REM     20 ENVEL 2,10,2.0
14740 REM     30 MUSIC 4000
14760 REM     40 PLAY 0:PLAY 17
14780 REM
```

```
14800 DATA 20,8A,AD,20,F7,B7,AC,80
14820 DATA 02,C8,C8,C8,C8,A5,14,99
14840 DATA 00,D4,60
14860 DATA ZZ
14880 REM
15000 DATA 9410, FILTFQ
15020 REM ****************************
15040 REM *        FILTFQ            *
15060 REM ****************************
15080 REM  REQUIRES ONE PARAMETER - THE
15100 REM CUTOFF   FREQUENCY   OF   THE
15120 REM FILTER (SEE 'VOL' & 'FILTER')
15140 REM FREQUENCY  IS IN RANGE  0  TO
15160 REM 2048. E.G.
15180 REM       10 FILTFQ 1000
15200 REM
15220 DATA 20,8A,AD,20,F7,B7,A5,14
15240 DATA 8D,15,D4,4A,4A,4A,85,14
15260 DATA A5,15,0A,0A,0A,05,14,8D
15280 DATA 16,D4,60
15300 DATA ZZ
15320 REM
15400 DATA 9440, FILTER
15420 REM ****************************
15440 REM *         FILTER           *
15460 REM ****************************
15480 REM  REQUIRES ONE PARAMETER - THE
15500 REM FILTERS TO  SWITCH ON OR OFF.
15520 REM E.G. 1  FILTER 1 ON
15540 REM      2  FILTER 2 ON
15550 REM      4  FILTER 3 ON
15560 REM      7  ALL FILTERS ON
15570 REM      0  ALL FILTERS OFF
15580 REM OR COMBINATIONS. THE TOP FOUR
15600 REM BITS CONTROL THE RESONANCE OF
15620 REM THE FILTER.
15640 REM
15660 DATA 20,8A,AD,20,F7,B7,A5,14
15680 DATA 8D,17,D4,60
15700 DATA ZZ
15720 REM
16000 DATA 9460, SPRITE
16020 REM ****************************
16040 REM *          SPRITE          *
16060 REM ****************************
16080 REM  REQUIRES ONE PARAMETER - THE
16100 REM CURRENT SPRITE ON  WHICH  THE
16120 REM OTHER SPRITE COMMANDS ACT IE:
16140 REM 'COLSP', 'XSP' & 'YSP'. USE A
16160 REM LOOP TO DESIGNATE EACH SPRITE
16180 REM IN TURN. E.G.
16200 REM       10 FOR I=0 TO 7
16220 REM       20 SPRITE I:COLSP 1
16240 REM       30 NEXT I
16260 REM SPRITES ARE NUMBERED  0 TO 7.
16280 REM
16300 DATA 20,8A,AD,20,F7,B7,A5,14
16320 DATA 29,07,8D,B2,02,60
16340 DATA ZZ
16360 REM
16400 DATA 9490, MOBCTRL
16420 REM ****************************
16440 REM *         MOBCTRL          *
16460 REM ****************************
16480 REM  REQUIRES ONE PARAMETER - THE
16500 REM SPRITES THAT ARE TO BE TURNED
16520 REM ON.  'MOBCTRL' IS  INDEPENDANT
16540 REM OF THE 'SPRITE' COMMAND. E.G.
16560 REM      0   ALL SPRITES OFF
16580 REM    255   ALL SPRITES ON
16600 REM      1   SPRITE 0 ON
16620 REM      2   SPRITE 1 ON
16640 REM      4   SPRITE 2 ON   ETC.
16680 REM
16700 DATA 20,8A,AD,20,F7,B7,A5,14
16720 DATA 8D,15,D0,60
16740 DATA ZZ
16760 REM
16800 DATA 9490, COLSP
16820 REM ****************************
16840 REM *         COLSP            *
16860 REM ****************************
16880 REM  REQUIRES ONE PARAMETER - THE
16900 REM COLOUR  ( 0 TO 15 )   OF  THE
16920 REM CURRENT SPRITE. SEE  'SPRITE'
16940 REM FOR AN EXAMPLE.
16960 REM
17000 DATA 20,8A,AD,20,F7,B7,A5,14
17020 DATA AC,82,02,99,27,D0,60
```

```
17040 DATA ZZ
17060 REM
17100 DATA 9480, XSP
17120 REM ****************************
17140 REM *          XSP             *
17160 REM ****************************
17180 REM  REQUIRES ONE PARAMETER - THE
17200 REM X  COORDINATE OF THE  CURRENT
17220 REM SPRITE. IT  MUST  BE  BETWEEN
17240 REM 0 AND 511. ( ALTHOUGH NOT ALL
17260 REM WILL  BE ON THE SCREEN ). SEE
17280 REM 'YSP' FOR AN EXAMPLE.
17300 REM
17320 DATA 20,BA,AD,20,F7,B7,A9,00
17340 DATA AC,B2,02,F0,07,18,69,02
17360 DATA 88,4C,BB,94,A8,A5,14,99
17380 DATA 00,D0,A5,15,29,01,85,15
17400 DATA AC,B2,02,C8,B9,F4,94,85
17420 DATA 14,AD,10,D0,25,14,8D,10
17440 DATA D0,A5,15,D0,01,60,B9,FD
17460 DATA 94,85,14,AD,10,D0,05,14
17480 DATA 8D,10,D0,60,EA,FE,FD:::
17500 DATA FB,F7,EF,DF,BF,7F,EA,01
17520 DATA 02,04,08,10,20,40,80
17540 DATA ZZ
17560 REM
17600 DATA 9510, YSP
17620 REM ****************************
17640 REM *          YSP             *
17660 REM ****************************
17680 REM  REQUIRES ONE PARAMETER - THE
17700 REM Y  COORDINATE OF THE  CURRENT
17720 REM SPRITE. IT  MUST  BE  BETWEEN
17740 REM 0 AND 255. ( ALTHOUGH NOT ALL
17760 REM WILL  BE ON THE SCREEN ).  EG
17780 REM      10 SPRITE 0:COLSP 0
17800 REM      20 XSP 300:YSP 100
17820 REM
17840 DATA 20,BA,AD,20,F7,B7,A9,01
17860 DATA AC,B2,02,F0,07,18,69,02
17880 DATA 88,4C,1B,95,A8,A5,14,99
17900 DATA 00,D0,60
17920 DATA ZZ
17940 REM
50000 DATA ZZZZ:REM END OF PROGRAM DATA MARKER

READY.
```

Atari Multi-Mode Text

by Garry Whittaker

Much has been written about the problems of getting text onto a graphics screen with Atari home computers, but most of the solutions have relied on large amounts of data statements to define the character set in terms of plot positions, and virtually all have offered text in only one graphics mode. This short utility allows you to print text in any graphics mode.

The first listing is the actual machine code routine and should be saved before running. There is a checksum, so if upon running you receive the message 'You have a data error', correct the error in the data statements and re-run. The second listing is a demonstration of how to use the program.

As well as printing text on a graphics screen, the second listing also shows how the program can be used to obtain the following effects:

1 Printing text at any pixel on the screen.
2 Smooth pixel scrolling of a single character (good for animation).
3 Different sizes and textures of text. Produced by varying the internal graphics registers.
4 Large text can be produced in graphics 0 by treating each character position as a pixel.
5 Multiple character sets can be displayed onscreen at the same time.

After correctly typing in and running listing one, type in the necessary lines of listing two for the demo.

Nick Walker

```
100 REM NOTE THE REMARKS IN THIS PROG.
        MAKE IT LOOK LONG & DIFFICULT,
        IT IS NOT! THE ACTUAL ROUTINE
110 REM IS SHORT AND EASY TO USE IN
        YOUR OWN PROGRAMS - WHILE AT
        THE SAME TIME BEING A VERY
120 REM FLEXIBLE WAY OF DISPLAYING
        TEXT ON ANY ATARI GRAPHICS
        SCREEN - DO NOT BE AFRAID TO
```

```
130 REM EXPERIMENT
140 REM
150 REM  MULTI-MODE  | BY
160 REM  ATARI       |
170 REM  GRAPHICS    | Garry. J.
180 REM  INDEPENDANT |
190 REM  CHARACTERS  |   Whittaker
200 REM
210 REM ******ALL GRAPHIC MODE****
            TEXT DISPLAY
        *********DEMONSTRATION*****
220 REM
230 GOSUB 520:REM INITIALISE MC$ -
                  MAGIC ROUTINE
240 CHSET=PEEK(756)*256:REM ..........
 **CHARACTER SET POSITION DOES NOT ***
 **NEED TO START ON EVEN BOUNDARY  ***

250 CHWIDTH=8:REM CHARACTER WIDTH IN
                                  BITS

260 X=0:Y=0:REM X Y POSITION ONLY
                LIMITED BY GR. MODE...

270 GRMODE=7:REM .......GRAPHICS MODE
- NOTE THIS IS ONLY INCLUDED AS A  -
REMINDER THAT GR. MODE NEEDS TO BE SET

280 INK=0:REM FOREGROUND COLOUR - USE
              THE SAME PARAMETER AS
              COLOR IN BASIC          .

290 PAPER=9:REM BACKGROUND COLOUR.....

300 TEXT$="Hello readers of ":REM ....
NOTE THAT AS THE FIRST CALL IS TO THE
WHOLE ROUTINE TEXT$ DOES NOT END IN ↰
310 REM
320 REM ******ALL GRAPHIC MODE****
            TEXT DISPLAY
        *********TITLE PAGE*******
330 REM THE FOLLOWING ROUTINE DISPLAYS
        THE MAGIC TITLE PAGE. NOTE USE
        OF INK,PAPER,TEXT$,X,Y,CHWIDTH

340 REM ALSO NOTE THE USE OF POKE 87,9
        TO FOOL THE OPERATING SYSTEM
        INTO THINKING IT IS IN GR.9
350 REM THE PATTERNED EFFECT IS DUE
        TO GR.9 ACCEPTING DATA FOR
        EACH POINT RATHER THAN JUST A
360 REM COLOUR FROM INK AND PAPER TRY
        CHANGING THESE PARAMETERS.....
370 GOSUB 690:X=A:INK=2:TEXT$="PCW↰":G
OSUB 710:X=A:TEXT$="This is ↰":GOSUB 7
10
380 X=A:INK=2:PAPER=3:TEXT$="20↰":GOSU
B 710:X=A:INK=2:PAPER=1:TEXT$=" Char/L
ine↰":GOSUB 710
390 Y=8:FOR X=25 TO 80 STEP 1:Y=Y+1:PA
PER=X-19:INK=PAPER-2:TEXT$="MAGIC↰":GO
SUB 710:NEXT X
400 FOR Y=64 TO 58 STEP -1:PAPER=Y-56:
INK=PAPER-2:X=X+1:GOSUB 710:NEXT Y
410 Y=8:FOR X=80 TO 25 STEP -1:Y=Y+1:P
APER=X-19:INK=PAPER-2:TEXT$="MAGIC↰":G
OSUB 710:NEXT X
420 X=17:Y=35:POKE 87,9:GOSUB 710:REM
YOU CAN STILL FOOL THE OPERATING SYSTE
M WITH POKE 87,GRAPHICS MODE
```

```
430 ? "PRESS ANY KEY TO CONTINUE"
440 POKE 764,255
450 IF PEEK(764)=255 THEN 450
460 GRAPHICS 8:X=8:Y=0:INK=255:PAPER=3
2:TEXT$="Multimode Atari Graphics Inde
pendant"
470 FOR CHWIDTH=3 TO 8:GOSUB 710:NEXT
CHWIDTH:REM YOU CAN VARY THE WIDTH IN
BITS OF THE CHARACTERS
480 CHWIDTH=7:TEXT$="CHARACTERS":X=8:
Y=Y+10:GOSUB 710:POKE 87,7:X=4:GOSUB 7
10:X=2:POKE 87,9:GOSUB 710
490 END
500 REM THE FOLLOWING CODE IS WHAT
        ACTUALLY DOES THE WORK I WOULD
        SUGGEST YOU LIST IT TO CASSTTE

510 REM OR DISK FOR INCLUSION IN YOUR
        OWN PROGRAMS
520 REM ********ALL GRAPHIC MODE*****
                TEXT DISPLAY
        ************INITIALISE********

530 REM
540 DIM MC$(210),TEXT$(256)
550 MC$="hh,Uh,Thh,Uh,Wh,Xhh,Yh,Ih,Zhh

,Zhh,b1↗,]♥8e↑,I(@)p/1%T8"
560 MC$(LEN(MC$)+1)="P┤◆▬  0└I◆0/8└ 80
\I  0┘┴i@80 0R┐a%└┐^%K┐_"♥%a┴e^┐^)♥e▬┐
h◆/Pn  ♥%T┐U  ┐V    ♥▬H"
570 MC$(LEN(MC$)+1)="┴eU┐T1^┴x┐a%b3 %7
┐O┐H"
580 MC$(LEN(MC$)+1)="%◆ 7Uh┘┴%ahdYPdh(
H@/PG%U┐T%V┐U80 "
590 GOSUB 740
600 RETURN
610 REM
620 REM ********ALL GRAPHIC MODE*****
                TEXT DISPLAY
        ************EXECUTE*********

630 REM
640 REM THE FOLLOWING CODE SHOULD BE
        CALLED TO EXECUTE MAGIC - IT
        IS POSSIBLE TO BYPASS THE 1ST
650 REM TWO LINES BY SETTING GRAPHICS
        MODE & PUTTING A CTRL 2 "" ON
        THE END OF TEXT$ BEFORE GOSUB
660 REM NOTE-PARAMETERS IN USR CALL
        ARE : MC$-MAGIC CODE STRING,
        X,Y-POSITION TO PRINT TEXT$,
670 REM CHSET - ADDRESS IN BYTES OF
        CHARACTER SET - NOTE DOES NOT
        NEED TO BE ON A PAGE BOUNDARY
680 REM CHWIDTH- CHARACTER WIDTH IN
        BYTES, INK-FOREGROUND & PAPER
        -BACKGROUND COLOUR

690 TEXT$(LEN(TEXT$)+1)=""
700 GRAPHICS GRMODE
710 A=USR(ADR(MC$),X,Y,CHSET,CHWIDTH,A
DR(TEXT$),INK,PAPER)
720 RETURN
730 REM ********ALL GRAPHIC MODE*****
                TEXT DISPLAY
        ******USE CORRECT OS CALL...

740 SD=PEEK(58390)+PEEK(58391)*256+1
750 SDH=INT(SD/256):SDL=SD-SDH*256
760 MC$(156,156)=CHR$(SDL):MC$(157,157
)=CHR$(SDH)
770 RETURN
```

BBC Smooth Scroller

by Andrew Thomas

You may have seen, in some of the commercial software available for the BBC Model B, text scrolling across the screen. One way to do this is to use the commands MID$ and LEFT$, but the text scrolls at a jerky eight pixels or one character at a time. This short utility moves text or graphics across the screen in mode two at a much smoother two pixels at a time.

The first few lines of the program give an example of how the routine scroll can be called for use within any program. For those who want the technicalities, lines 180 to 270 do the actual scrolling. It works by getting an address in &78,&79, adding on eight and then storing in &74,&75. The character block in &74,&75 is then shifted left into &70,&71, and the two addresses are incremented by eight until the end of the line is reached.

If you have OS 0.10 you will have to remove line 300. This is the equivalent of the Basic *FX 19, which waits until the start of the sync to produce smoother graphics and scrolling.

```
 60REM ****      ANDREW THOMAS
 70REM ****      Machine:BBC 32K
 80REM ****      Model B
 90REM ****      1.00 O.S. or above
100REM **** Smooth Scrolling text,in Mode 2 ****
110REM **** (C) Copyright A.J.Thomas 1984 ****
120MODE2
130VDU23;10,32,0;0;0;23,224,66,36,255,153,189,231,90,195
140DIM TEXT 255
150$TEXT="This is an example of smooth scrolling in mode
   2.It could be used for titles in games, or for scrolling
   little   characters "+CHR$224+CHR$224+CHR$224+"
   What ever you wish!  "+CHR$224+"    "+CHR$224+"
160?&80=0:?&81=0
170PROCASS:COLOUR2:PRINTTAB(0,4);
"You may use the    'scroll' routine in your programs."
180COLOUR1
190CALLmain
200COLOUR7
210END
220DEFPROCASS
230DIM CODE 200
240FORI%=0TO2STEP2
250P%=CODE
260[OPTI%
270.scroll LDA£0:STA&78:LDA&7C:STA&70:LDA&7D:
   STA&71:LDA&7C:CLC:ADC£8:STA&74:LDA&7D:
   ADC£0:STA&75:LDY£0

280.scloop
290LDA(&74),Y:STA(&70),Y
300INY:CPY£8:BNE scloop
310LDY£0
320LDA&70:CLC:ADC£8:STA&70:LDA&71:ADC£0:STA&71
330LDA&74:CLC:ADC£8:STA&74:LDA&75:ADC£0:STA&75
340INC&78
350LDA&78:CMP£80:BNEscloop
360RTS
370.getnums JSRcheck:.gnloop
380LDA£&0:STA&7C:LDA£&5D:STA&7D:JSRscroll
390LDA£19:JSR&FFF4
```

```
400RTS
410.ptext
420LDX&80
430LDA£31:JSR&FFEE:LDA£19:
   JSR&FFEE:LDA£18:JSR&FFEE
440LDA TEXT,X:JSR&FFEE
450INC&80:LDA£0:STA&81
460RTS:.check INC&81:LDA&81:CMP£4:BEQptext
470RTS
480.main
490JSRgetnums
500LDA£167:CMP&80:BNEmain
510RTS:]
520NEXT
530ENDPROC
```

BBC Anti-List Utility

by Daniel Greenspan

This is a short but powerful utility for the BBC Micro; it will protect any Basic program from being listed.

Instructions

1 Type in and run the program with a blank tape or disk installed.
2 Load the program to be protected.
3 If using tape rewind and press PLAY.
4 SAVE your program in the normal program.
5 List your program.

```
10 REM **PROTECTION UTILITY**
20 *SPOOL PRTEC
30 PRINT "REN. 20,20"
40 FOR I=10 TO 4000 STEP 20
50 PRINT;I;"REM !!!!"
60 NEXT I
70 FOR I=1 TO 100:X=RND(4000)
80 IF X MOD 10 = 0 THEN NEXT I
90 PRINT;X;"REM !!!!"
100 IF I<90 THEN NEXT I
110 PRINT "FOR I=PAGE TO TOP:IF
    ?I=33 AND I?1=33 AND I?2=33
    AND I?3=33 THEN
    ?I=6:I?1=7:I?2=
    12:I?3=21:N. I:ELSE: N.I"
120 PRINT "20000REM!!!!"
130 PRINT "FOR I=PAGE TO TOP:IF
    ?I=33 AND I?1=33 AND I?2=33
    AND I?3=33 THEN ?I=6:I?1=7:
    I?2=12:I?3=6:N. I:ELSE: N.I"
140 PRINT "REN."
150 *SPOOL
```

Controller

by B Thomas and D Stevens

"It is the year 2048. Our Earth is under threat of explosion. Earth's internal forces are reaching critical pressure and it is inexorably heading for total destruction.

You have been called upon by the Joint Assembly to help save your fellow humans by using the new shuttle guidance system built by the International Aerospace Council against this very day. The lives of billions of people will be in your hands.

You will need all the manual dexterity you possess if you are to help your fellow man reach the New Earth. Since this is such a mammoth task, it is not expected that you will transport all of humanity by yourself. Therefore, a points system has been implemented which will determine the best 'CONTROLLER' on Earth. Your name will then be written in the annals of human endeavour."

That's the introduction supplied with a lengthy source code listing by Messrs Thomas and Stevens. With the assistance of Geoff Lohrere, who converted this source code to Basic DATA statements, we have been able to condense the listing to a length suitable for publication in *APC*.

Geoff Lohrere's loading instructions follow:

1 Type in and 'CSAVE' loader with checksum system.

2 Type in and 'CSAVE' segment '1'.

3 Type in and 'CSAVE' segment '2'. (Note: the segments should be typed exactly as shown in the listing, ie, with no additional spaces, etc.)

4 'CLOAD' loader with checksum system and 'RUN'. (Loader will reply with the message 'Ready segment 1 and ENTER').

5 Prepare cassette with segment 1 and press 'ENTER'. (The loader will read the data tape, converting data read to true hex and load each byte converted into memory. The byte at the end of each line is the checksum byte. If the loader finds an incorrectly typed line, the cassette load will terminate and the loader will report with the message 'Error in (line containing error)'. If an error is reported, the segment containing the error should be 'CLOADed', the line containing the error corrected and 'CSAVEd' again and step four recommenced. If segment '1' contains no errors the loader will reply with the message 'Ready segment 2 and ENTER'.)

6 Prepare cassette with segment 2 and press 'ENTER'. (If segment 2 contains no errors, on completion of the data tape read, the program will self run.) People wishing to make a 'SYSTEM' tape of this program may prevent the program from self running by deleting ':X=USR(0)' from the end of line 20 in the loader. The parameters are Start=5200H End=6932H Entry or Transfer address=6491H.

Loader program

```
10 CLS:FORX=17664TO17754:READ A:POKEX,A:NEXT:POKE16526,0:POKE16527,69:INPUT"Ready Segment
1 And Enter";:X=USR(0)
20 INPUT"Ready Segment 2 And Enter";:PRINT:X=USR(0):POKE16526,145:POKE16527,100:X=USR(0)
30 DATA 17,0,82,205,147,2,205,20,3,205,20,3,237,83,1,69,205,20,3,167,200,205,20,3,217,205
,20,3,217,14,0
40 DATA 205,80,69,7,7,7,7,71,205,80,69,128,18,19,65,129,79,205,53,2,167,32,233,205,44,2,27
,26,184,40,206
50 DATA 229,33,30,25,205,117,43,35,205,117,43,225,205,175;15,195,204,6,205,53,2,214,48,254
,10,216,214,7,201
```

```
1 DATA 59,4F,55,52,20,56,44,55,20,48,41,53,20,4E,4F,57,20,42,45,45,4E,20,53,57,49,54,0F
2 DATA 43,48,45,44,20,54,4F,20,4F,56,45,52,4D,4F,4E,49,54,4F,52,49,4E,47,59,4F,55,20,56
3 DATA 41,52,45,20,4E,4F,57,20,49,4E,20,4F,55,52,20,43,4F,4D,50,4C,45,54,45,20,43,4F,E4
4 DATA 4E,54,52,4F,4C,2E,42,45,20,50,52,45,50,41,52,45,44,20,3A,20,59,4F,55,20,41,52,E1
5 DATA 45,20,41,42,4F,55,54,20,54,4F,20,55,53,45,20,41,20,4E,45,57,20,53,48,55,54,54,D3
6 DATA 4C,45,20,47,55,49,44,41,4E,43,45,20,53,59,53,54,45,4D,43,4F,44,45,20,4E,41,4D,0D
7 DATA 45,44,2E,2E,2E,2E,2E,2E,2E,2E,2A,2A,20,43,4F,4E,54,52,4F,4C,4C,45,52,20,2A,2A,E5
8 DATA 20,20,20,20,42,59,20,42,52,41,44,20,54,48,4F,4D,41,53,20,41,4E,44,20,44,41,4E,26
9 DATA 20,53,54,45,56,45,4E,53,2E,20,20,28,43,29,28,50,29,20,31,39,38,33,20,20,20,20,60
10 DATA 50,52,45,53,53,20,3C,45,4E,54,45,52,3E,20,46,4F,52,20,49,4E,53,54,52,55,43,54,48
11 DATA 49,4F,4E,53,2C,20,4F,52,20,3C,43,4C,45,41,52,3E,20,54,4F,20,53,54,41,52,54,20,B8
12 DATA 47,41,4D,45,20,20,20,20,53,43,4F,52,45,20,3D,20,53,48,55,54,54,4C,45,20,55,4E,7F
13 DATA 44,45,52,20,43,4F,4E,54,52,4F,4C,20,3D,20,43,52,41,53,48,20,41,4C,4C,4F,57,41,EA
14 DATA 4E,43,45,20,3D,20,43,52,41,53,48,20,41,4C,4C,4F,57,41,4E,43,45,20,48,41,53,20,96
15 DATA 4E,4F,57,20,52,45,41,43,48,45,44,20,5A,45,52,4F,43,52,41,53,48,20,41,4C,4C,4F,19
16 DATA 57,41,4E,43,45,20,43,52,49,54,49,43,41,4C,21,21,4C,45,56,45,4C,20,3D,20,54,41,A5
17 DATA 53,4B,20,4F,42,4A,45,43,54,49,56,45,20,3A,20,4C,41,4E,44,20,53,48,55,54,54,4C,F6
18 DATA 45,53,20,53,41,46,45,4C,59,20,4F,4E,20,50,4C,41,4E,45,54,20,46,4F,52,20,50,4F,E3
19 DATA 49,4E,54,53,53,48,55,54,54,4C,45,20,53,45,4C,45,43,54,49,4F,4E,20,3A,20,50,52,49
20 DATA 45,53,53,20,31,20,2D,20,39,53,48,55,54,54,4C,45,20,43,4F,4E,54,52,4F,4C,20,3A,A6
21 DATA 20,50,52,45,53,53,20,5B,20,5C,20,5D,20,5E,20,3C,20,3E,50,4F,49,4E,54,20,56,41,9A
22 DATA 4C,55,45,53,20,3A,20,31,30,30,20,58,20,53,48,55,54,54,4C,45,20,4E,55,4D,42,45,9C
23 DATA 52,20,4C,41,4E,44,45,44,20,2B,20,31,30,30,30,20,42,4F,4E,55,53,20,50,4F,49,4E,43
24 DATA 54,53,47,41,4D,45,20,45,4E,44,53,20,49,46,20,43,52,41,53,48,20,41,4C,4C,4F,57,EA
25 DATA 41,4E,43,45,20,52,45,41,43,48,45,53,20,5A,45,52,4F,42,4F,4E,55,53,20,41,4C,4C,12
26 DATA 4F,57,41,4E,43,45,20,46,4F,52,20,53,55,43,43,45,53,53,46,55,4C,4C,59,20,43,4F,3B
27 DATA 4D,50,4C,45,54,49,4E,47,20,45,41,43,48,20,4C,45,56,45,4C,5C,20,54,48,45,20,53,F9
28 DATA 48,55,54,54,4C,45,53,20,5C,A6,31,99,20,A6,32,99,20,A6,33,99,20,A6,34,99,20,A6,91
29 DATA 35,99,20,A6,36,99,20,A6,37,99,20,A6,38,99,20,A6,39,99,20,5C,20,54,48,45,20,50,15
30 DATA 4C,41,4E,45,54,20,5C,50,52,45,53,53,20,3C,43,4C,45,41,52,3E,20,54,4F,20,53,54,08
31 DATA 41,52,54,20,47,41,4D,45,20,20,20,20,20,20,20,20,20,20,20,20,20,20,20,20,20,20,61
32 DATA 20,20,20,20,20,20,20,20,20,20,20,20,20,20,20,20,20,20,20,20,20,20,20,20,20,20,40
```

```
 33 DATA 20,20,20,20,20,20,20,20,20,20,20,20,20,20,20,20,20,20,20,20,80,80,80,80,80,80,80
 34 DATA 80,80,80,80,80,80,80,80,80,80,80,80,80,80,80,20,20,20,20,20,20,93,52,3E,03,11,27,1E
 35 DATA 5F,12,CD,24,44,21,F3,53,CD,A4,5D,CD,0B,56,22,95,51,0E,00,CD,03,4B,C2,72,56,2A,EE
 36 DATA CE,4D,ED,5B,95,51,AF,ED,52,28,06,21,F8,52,C3,96,52,11,00,00,7A,B3,28,16,21,0B,23
 37 DATA 54,CD,A4,5D,CD,0B,56,22,CE,4D,3A,86,55,4F,CD,0F,4B,C2,72,56,2A,CE,4D,11,00,00,F8
 38 DATA 7A,B3,C8,22,E9,55,3A,86,55,4F,CD,5F,44,1E,02,21,00,42,CD,2F,4B,C2,72,56,2E,40,EB
 39 DATA 7E,E6,F8,FE,10,20,10,7D,C6,10,6F,D5,11,00,00,73,2C,72,2C,73,2C,72,D1,7D,E6,E0,A4
 40 DATA C6,20,6F,30,E1,21,00,42,CD,FB,44,C2,72,56,1C,7B,FE,0A,38,C7,C9,06,08,21,00,60,55
 41 DATA CD,40,00,EB,26,00,68,19,3E,08,90,47,3E,20,77,23,10,FC,C3,2B,51,CD,A5,51,CD,15,A4
 42 DATA 5F,28,03,21,7D,47,22,3A,44,C9,C5,D5,E5,3A,40,38,E6,04,20,25,CD,2B,00,FE,60,28,B6
 43 DATA 0C,FE,40,28,08,AF,E1,D1,C1,C9,C5,D5,E5,3A,40,38,E6,04,20,0B,CD,2B,00,B7,28,F3,75
 44 DATA AF,E1,D1,C1,C9,AF,32,15,43,32,0F,43,3E,C9,32,12,43,C3,30,40,F6,40,CD,09,44,C3,7C
 45 DATA 30,40,11,27,5F,CD,1C,44,C2,89,52,11,47,5F,CD,1C,44,C2,89,52,06,00,21,00,60,CD,A6
 46 DATA 24,44,20,DC,DD,21,47,5F,DD,46,07,DD,4E,06,CD,D4,4A,20,CD,3E,04,85,6F,7E,32,C5,E6
 47 DATA 56,32,D2,56,B7,28,1E,11,47,5F,CD,28,44,20,B7,FD,26,44,FD,2E,0C,FD,35,00,06,00,4A
 48 DATA 11,47,5F,21,00,60,CD,24,44,20,A1,06,00,11,27,5F,21,00,6F,CD,24,44,20,94,11,47,9C
 49 DATA 5F,CD,48,44,C3,61,57,11,27,5F,CD,1C,44,C2,89,52,11,47,5F,CD,1C,44,C2,89,52,21,36
 50 DATA 27,5F,7E,FE,3A,28,07,FE,20,38,21,23,18,F4,23,7E,FE,30,20,18,21,47,5F,7E,FE,3A,95
 51 DATA 28,07,FE,20,38,0C,23,18,F4,23,7E,FE,30,20,03,32,4A,57,06,00,11,27,5F,21,00,60,A3
 52 DATA CD,24,44,C2,72,56,DD,21,27,5F,DD,46,07,DD,4E,06,CD,D4,4A,C2,72,56,3E,04,85,6F,49
 53 DATA 46,3E,00,B7,C4,07,58,11,47,5F,21,00,61,CD,20,44,C2,72,56,3A,4A,57,B7,20,31,11,46
 54 DATA 27,5F,CD,13,00,28,0B,47,E6,FE,FE,1C,78,28,0E,C3,72,56,11,47,5F,CD,1B,00,28,E5,C3
 55 DATA C3,72,56,11,47,5F,CD,28,44,C2,72,56,11,27,5F,CD,28,44,C2,72,56,C9,2A,49,40,11,EC
 56 DATA 00,01,B7,ED,52,22,BA,57,CD,02,58,01,00,62,11,27,5F,CD,13,00,28,0B,5F,E6,FE,FE,9F
 57 DATA 1C,7B,28,12,C3,72,56,02,03,21,00,00,B7,ED,42,30,E3,CD,E1,57,18,D8,CD,E1,57,11,86
 58 DATA 47,5F,CD,28,44,C2,72,56,CD,02,58,11,27,5F,CD,28,44,C2,72,56,C3,2D,40,CD,07,58,46
 59 DATA 60,69,01,00,62,B7,ED,42,44,4D,21,00,62,7E,11,47,5F,CD,1B,00,C2,72,56,23,0B,78,73
 60 DATA B1,20,F0,C9,21,3E,58,18,03,21,5F,58,C5,D5,E5,CD,67,44,01,56,02,CD,2B,00,FE,0D,87
 61 DATA 28,13,0B,78,B1,20,F4,3E,00,EE,01,32,20,58,28,E5,CD,34,58,18,E3,CD,34,58,E1,D1,C6
 62 DATA C1,C9,3E,1D,CD,33,00,3E,1E,C3,33,00,1D,1E,49,4E,53,45,52,54,20,53,4F,55,52,43,F3
 63 DATA 45,20,44,49,53,4B,45,54,54,45,20,3C,45,4E,54,45,52,3E,03,1D,1E,49,4E,53,45,52,99
 64 DATA 54,20,44,45,53,54,49,4E,41,54,49,4F,4E,20,44,49,53,4B,45,54,54,45,20,3C,45,4E,22
 65 DATA 54,45,52,3E,03,01,00,70,ED,43,1A,59,ED,43,20,59,01,2D,40,ED,43,5D,59,11,27,5F,D4
 66 DATA CD,1C,44,C2,89,52,11,6E,54,CD,76,44,11,21,5F,21,27,5F,06,06,7E,FE,30,38,1B,FE,65
 67 DATA 3A,38,10,FE,41,38,13,FE,5B,38,08,FE,61,38,0B,FE,7B,30,07,12,23,13,10,E2,18,06,4F
 68 DATA 3E,20,12,13,10,FA,11,27,5F,21,6E,59,CD,73,44,06,00,21,00,60,CD,20,44,C2,72,56,D2
 69 DATA 3E,05,CD,1B,00,3E,06,CD,1B,00,06,06,21,21,5F,7E,23,CD,1B,00,10,F9,2A,20,59,ED,26
 70 DATA 4B,1A,59,AF,ED,42,21,24,53,DA,96,52,21,FF,6F,ED,42,21,39,53,D2,96,52,21,00,00,3C
 71 DATA E5,44,4D,21,00,00,23,AF,ED,42,28,29,06,FE,7C,B7,20,06,7D,FE,FF,30,01,45,E1,3E,55
 72 DATA 01,CD,1B,00,78,C6,02,CD,1B,00,7D,CD,1B,00,7C,CD,1B,00,7E,23,CD,1B,00,10,F9,18,84
 73 DATA CB,E1,3E,02,CD,1B,00,3E,02,CD,1B,00,21,00,00,7D,CD,1B,00,7C,CD,1B,00,CD,28,44,1F
 74 DATA C2,72,56,C9,43,49,4D,11,27,5F,CD,1C,44,C2,89,52,7E,FE,21,20,0A,FD,26,44,FD,2E,E6
 75 DATA 0C,FD,36,00,FF,CD,24,44,C2,72,56,CD,2C,44,C2,72,56,C9,01,00,00,ED,43,B8,59,11,E0
 76 DATA 27,5F,CD,1C,44,C2,89,52,01,87,54,CD,76,44,06,00,21,00,60,CD,24,44,C2,72,55,57,4F
 77 DATA 70,56,E8,58,0D,57,38,58,EA,55,F9,55,2F,56,44,56,62,56,B9,56,C5,56,1E,57,2C,57,80
 78 DATA 4C,57,8A,57,A0,57,BC,57,ED,57,4A,58,5E,58,6A,58,94,58,C0,58,EB,58,0F,59,1E,59,12
 79 DATA 80,59,B2,59,6C,56,C2,56,5A,57,CC,57,F0,57,3A,58,BE,58,D0,58,E4,58,F0,58,E2,56,65
 80 DATA 00,00,00,00,00,00,00,01,00,00,00,00,00,80,80,80,80,80,80,80,80,00,00,00,00,00,01
 81 DATA 00,00,00,00,00,00,00,00,00,00,BF,00,00,00,00,00,00,00,00,BF,00,00,00,00,00,00,BF,3D
 82 DATA 00,00,00,00,00,00,00,BF,00,00,00,00,00,00,00,00,BF,00,00,00,00,00,00,00,BF,00,00,3D
 83 DATA 00,00,00,00,00,BF,00,00,00,00,00,00,00,BF,00,00,00,00,00,00,00,BF,00,00,00,00,3D
 84 DATA 00,00,00,BF,00,00,00,00,00,00,00,BF,00,00,00,00,00,00,00,BF,80,80,80,80,80,80,3D
 85 DATA 80,80,80,80,80,80,80,80,80,80,80,80,80,80,80,80,80,80,80,80,80,80,80,80,80,80,00
 86 DATA 80,80,80,80,80,80,80,80,80,80,80,80,80,80,80,80,80,80,80,80,80,80,80,80,80,80,00
 87 DATA 80,80,80,80,80,80,80,80,80,80,80,80,80,80,80,80,80,80,80,80,80,80,80,80,80,80,00
 88 DATA 80,80,80,80,B0,BC,BF,BF,BC,B0,00,00,20,20,20,20,20,20,53,4F,52,52,59,20,2D,20,4E,50
 89 DATA 4F,20,42,4F,4E,55,53,21,20,20,20,20,20,47,20,41,20,4D,20,45,20,20,4F,20,56,20,56
 90 DATA 45,20,52,2A,20,31,30,30,30,20,42,4F,4E,55,53,20,50,4F,49,4E,54,53,20,46,4F,52,6D
 91 DATA 20,53,41,46,45,4C,59,20,43,4F,4E,54,52,4F,4C,4C,49,4E,47,20,41,4C,4C,20,53,48,03
 92 DATA 55,54,54,4C,45,53,20,2A,2A,20,32,30,30,30,20,42,4F,4E,55,53,20,50,4F,49,4E,54,88
 93 DATA 53,20,46,4F,52,20,4C,41,4E,44,49,4E,47,20,53,48,55,54,54,4C,45,53,20,49,4E,20,EA
 94 DATA 4E,55,4D,45,52,49,43,41,4C,20,53,45,51,55,45,4E,43,45,20,2A,2A,20,2A,20,43,4F,89
 95 DATA 4E,47,52,41,54,55,4C,41,54,49,4F,4E,53,20,2A,20,2A,59,4F,55,20,48,41,56,45,20,E0
 96 DATA 41,54,54,41,49,4E,45,44,20,4F,4E,45,20,4F,46,20,54,48,45,20,54,45,4E,20,48,49,BA
 97 DATA 47,48,45,53,54,50,4F,49,4E,54,20,52,41,54,49,4E,47,53,20,4F,46,20,41,4C,4C,20,0B
 98 DATA 43,4F,4E,54,52,4F,4C,4C,45,52,53,20,53,4F,20,46,41,52,2E,50,4C,45,41,53,45,20,1A
 99 DATA 45,4E,54,45,52,20,59,4F,55,52,20,4E,41,4D,45,20,4F,52,20,49,4E,49,54,49,41,4C,19
100 DATA 53,50,52,45,53,53,20,3C,45,4E,54,45,52,3E,20,57,48,45,4E,20,43,4F,52,52,45,43,28
101 DATA 54,2A,2A,20,48,49,47,48,20,53,43,4F,52,45,53,20,2A,2A,AD,59,00,00,00,00,BF,83,93
102 DATA 83,83,80,80,BF,83,83,BF,80,80,BF,BF,83,BF,80,80,83,BF,83,83,80,80,BF,B3,B3,BF,76
103 DATA 80,80,BF,83,83,BF,80,80,BF,80,80,80,80,80,BF,80,80,80,80,80,BF,B3,B3,83,80,80,AA
104 DATA BF,B3,B3,BF,80,80,80,80,80,80,BF,BF,B0,B0,80,80,BF,BF,B0,BF,80,80,BF,80,80,BF,2D
105 DATA 80,80,80,BF,BF,80,80,80,80,BF,80,83,BC,80,80,BF,BF,B0,BF,80,80,BF,BF,B0,B0,80,80,C7
106 DATA BF,BF,B0,B0,80,80,BF,BF,B0,B0,80,80,80,BF,80,83,BC,42,45,57,41,52,45,21,20,53,4B,CF
107 DATA 59,4D,49,4E,45,53,21,00,00,00,00,21,00,3C,36,80,11,01,3C,01,FF,03,ED,B0,C9,3E,FE
108 DATA 05,F5,01,00,00,CD,60,00,F1,3D,20,F5,C9,3A,08,5D,4F,3A,07,5D,47,3E,01,D3,FF,10,28
109 DATA FE,3A,07,5D,47,3E,02,D3,FF,10,FE,0D,20,E9,C9,00,00,21,00,3C,01,00,04,7E,CB,7F,0C
110 DATA 28,03,EE,3F,77,23,0B,78,B1,20,F2,C9,06,40,3E,05,32,08,5D,C5,21,3F,3C,06,10,36,CE
111 DATA BF,11,40,00,19,10,F8,21,01,3C,11,00,3C,01,FF,03,ED,B0,ED,5F,32,07,5D,CD,EB,5C,72
112 DATA C1,10,DC,DD,21,B6,55,06,40,C5,DD,E5,FD,21,3F,3C,06,10,DD,7E,00,FD,77,00,11,40,52
113 DATA 00,DD,19,FD,19,10,F1,06,10,21,00,3C,36,80,11,40,00,19,10,F8,21,01,3C,11,00,3C,53
114 DATA 01,FF,03,ED,B0,ED,5F,32,07,5D,CD,EB,5C,DD,E1,DD,23,C1,10,C1,3A,0D,5A,3C,32,0D,02


  1 DATA 5A,AF,C9,06,40,3E,05,32,08,5D,C5,21,00,3C,06,10,36,BF,11,40,00,19,10,F8,21,FE,B0
  2 DATA 3F,11,FF,3F,01,FF,03,ED,B8,ED,5F,32,07,5D,CD,EB,5C,C1,10,DC,DD,21,F5,55,06,40,67
  3 DATA C5,DD,E5,FD,21,00,3C,06,10,DD,7E,00,FD,77,00,11,40,00,DD,19,FD,19,10,F1,06,10,3A
  4 DATA 21,3F,3C,36,80,11,40,00,19,10,F8,21,FE,3F,11,FF,3F,01,FF,03,ED,B8,ED,5F,32,07,9E
  5 DATA 5D,CD,EB,5C,DD,E1,DD,2B,C1,10,C1,3E,01,32,0D,5A,C9,3A,67,5E,EE,01,32,67,5E,FE,4D
  6 DATA 01,28,04,36,20,18,02,36,8F,01,2C,01,FD,E5,D5,CD,2B,00,B7,20,0A,0B,78,B1,20,F5,69
```

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7 DATA D1,FD,E1,18,D8,D1,FD,E1,FE,0D,20,03,36,80,C9,FE,08,20,0D,36,20,2B,7E,FE,80,C2,6D
8 DATA 0D,5E,23,C3,0D,5E,FE,20,FA,0D,5E,FE,5C,F2,0D,5E,77,23,7E,FE,80,C2,0D,5E,2B,C3,A7
9 DATA 0D,5E,00,00,21,0C,5A,3E,30,11,3E,3C,ED,6F,FE,30,28,02,12,13,ED,6F,12,ED,6F,3E,CC
10 DATA 80,13,12,C9,21,21,5A,04,23,10,FD,7E,81,FE,0A,FA,9C,5E,D6,0A,77,23,7E,FE,BF,28,16
11 DATA 03,3C,18,EF,77,21,22,5A,22,3E,5C,11,28,5A,21,08,3C,1A,B7,20,13,1B,36,80,23,E5,EB
12 DATA 2A,3E,5C,CD,39,0A,E1,20,EE,1A,C6,30,77,C9,C6,30,77,E5,2A,3E,5C,CD,39,0A,E1,C8,E2
13 DATA 1B,23,1A,18,EF,DD,21,6E,55,AF,06,09,DD,77,00,11,08,00,DD,19,10,F6,DD,21,6E,55,08
14 DATA 3E,31,2E,A6,26,99,06,09,DD,75,01,DD,77,02,DD,74,03,3C,11,08,00,DD,19,10,EF,DD,35
15 DATA 21,6E,55,21,F8,55,06,09,DD,75,04,DD,74,05,11,06,00,19,11,08,00,DD,19,10,EF,DD,28
16 DATA 21,6E,55,11,02,00,21,40,00,06,04,DD,73,06,DD,72,07,DD,75,0E,DD,74,0F,C5,01,10,A4
17 DATA 00,DD,09,C1,10,EB,DD,73,06,DD,72,07,21,B6,55,36,80,11,B7,55,01,FF,03,ED,B0,C9,B6
18 DATA 3A,0C,5A,B7,20,1A,32,E1,5A,3A,07,5A,32,E0,5A,21,58,53,11,CE,3D,01,24,00,ED,B0,AF
19 DATA 01,00,00,CD,60,00,3A,E0,5A,47,3A,07,5A,B8,C0,47,3A,E1,5A,B7,20,04,D1,C3,62,60,E9
20 DATA B8,C2,42,60,3A,0C,5A,C6,02,27,32,0C,5A,CD,68,5E,01,01,03,CD,82,5E,21,0D,5B,11,22
21 DATA 04,3E,01,39,00,ED,B0,2A,3C,5C,23,23,23,3E,31,32,0E,5A,3A,07,5A,47,ED,5B,3A,5C,0D
22 DATA CD,39,0A,CA,01,60,7E,23,FE,3A,F2,B2,5F,4F,3A,0E,5A,B9,C2,01,60,3C,32,0E,5A,10,CA
23 DATA E1,21,46,5B,11,40,3E,01,40,00,ED,B0,01,02,03,CD,82,5E,06,07,3E,0A,32,08,5D,3E,ED
24 DATA 1E,32,07,5D,C5,06,05,C5,CD,EB,5C,C1,10,F9,01,10,27,CD,60,00,C1,10,ED,01,00,00,4B
25 DATA CD,60,00,3A,0A,5A,3C,27,32,0A,5A,2A,08,5A,01,05,00,AF,ED,42,22,08,5A,2A,3C,5C,7A
26 DATA 01,04,00,AF,ED,42,3A,07,5A,3C,FE,0A,20,0C,3A,0B,5A,3C,32,0B,5A,3E,02,21,9D,59,B7
27 DATA 32,07,5A,22,3C,5C,C1,C3,52,67,21,E2,5A,11,D2,3D,01,1B,00,ED,B0,01,00,00,CD,60,EE
28 DATA 00,21,54,55,11,D7,3D,01,11,00,ED,B0,C1,C3,52,67,21,FD,5A,11,18,3E,01,10,00,ED,B8
29 DATA B0,CD,DD,5C,21,22,5A,22,3E,5C,21,21,5A,11,28,5A,CD,83,61,3A,AA,61,FE,02,CA,D2,D0
30 DATA 64,21,22,5A,22,3E,5C,11,28,5A,21,30,5A,D5,E5,CD,83,61,E1,D1,3A,AA,61,B7,C2,B3,89
31 DATA 60,D5,11,80,5A,CD,39,0A,D1,CA,D2,64,01,08,00,09,C3,93,60,E5,D5,C5,CD,40,5F,21,D5
32 DATA A6,52,11,D0,55,01,10,00,ED,B0,21,86,5B,11,4C,56,01,17,00,ED,B0,21,9D,5B,11,C4,34
33 DATA 56,01,28,00,ED,B0,21,C5,5B,11,04,57,01,28,00,ED,B0,21,ED,5B,11,87,57,01,22,00,0A
34 DATA ED,B0,21,0F,5C,11,CB,57,01,1A,00,ED,B0,21,22,5A,22,3E,5C,11,28,5A,21,B6,55,CD,F9
35 DATA A9,5E,3A,0D,5A,FE,01,CC,1E,5D,FE,02,CC,97,5D,21,68,55,11,9E,3E,01,05,00,ED,B0,1C
36 DATA 21,9E,3E,CD,0D,5E,21,9E,3E,11,17,5A,01,04,00,ED,B0,C1,D1,E1,01,06,00,AF,ED,42,AE
37 DATA E5,11,08,00,19,EB,E1,E5,D5,11,7A,5A,EB,AF,ED,52,E5,C1,D1,E1,E5,78,B1,CA,68,61,54
38 DATA C5,11,81,5A,21,79,5A,ED,B8,C1,11,D9,5A,21,D1,5A,ED,B8,D1,D5,21,22,5A,01,08,00,8C
39 DATA ED,B0,D1,21,58,00,19,EB,21,13,5A,01,08,00,ED,B0,C3,D2,64,1A,BE,20,0E,E5,2A,3E,6B
40 DATA 5C,CD,39,0A,E1,28,13,1B,2B,18,EE,FA,9E,61,3E,01,32,AA,61,C9,3E,00,32,AA,61,C9,56
41 DATA 3E,02,32,AA,61,C9,00,DD,21,6E,55,3A,07,5A,47,DD,7E,00,FE,01,28,1E,FE,02,CA,71,C4
42 DATA 62,FE,03,CA,AD,62,DD,5E,04,DD,56,05,DD,23,DD,E5,DD,2B,E1,C5,01,03,00,ED,B0,C1,85
43 DATA 11,08,00,DD,19,10,D4,21,F6,55,11,40,3C,01,C0,03,ED,B0,C9,DD,21,6E,55,3A,07,5A,72
44 DATA 47,DD,7E,00,B7,20,1A,DD,6E,04,DD,66,05,C5,06,03,DD,E5,DD,23,DD,7E,00,BE,C2,1B,B0
45 DATA 62,23,10,F4,DD,E1,C1,11,08,00,DD,19,10,D9,C9,DD,E1,DD,6E,04,DD,66,05,36,80,23,F7
46 DATA 36,80,23,36,80,21,F6,55,11,40,3C,01,C0,03,ED,B0,3E,05,32,08,5D,3E,5A,32,07,5D,F1
47 DATA 3E,04,F5,CD,09,5D,CD,EB,5C,F1,3D,20,F5,C1,3E,01,DD,77,00,3E,20,32,E7,55,3A,E0,FB
48 DATA 5A,3C,32,E0,5A,3A,0C,5A,B7,CA,4A,64,3D,27,32,0C,5A,CD,68,5E,C3,13,62,C5,3E,05,A0
49 DATA 32,08,5D,3E,5A,32,07,5D,3E,04,F5,CD,09,5D,CD,EB,5C,F1,3D,20,F5,C1,3E,01,DD,77,DA
50 DATA 00,3E,20,32,E7,55,3A,E0,5A,3C,32,E0,5A,3A,0C,5A,B7,CA,D8,61,3D,27,32,0C,5A,CD,0B
51 DATA 68,5E,C3,D8,61,C5,06,02,DD,6E,04,DD,66,05,7E,EE,3F,77,23,23,10,F8,21,F6,55,11,13
52 DATA 40,3C,01,C0,03,ED,B0,C1,C3,D8,61,ED,4B,08,5A,D5,FD,E5,CD,2B,00,B7,20,2D,FD,E1,C5
53 DATA D1,3A,40,38,FE,08,CA,49,63,FE,10,CA,4E,63,FE,20,CA,3F,63,FE,40,CA,44,63,3A,20,1B
54 DATA 38,FE,10,CA,3F,63,FE,40,CA,44,63,0B,78,B1,20,CB,C9,FD,E1,D1,F5,3A,10,5A,B7,28,70
55 DATA 05,F1,D1,C3,D2,64,F1,FE,31,FA,D1,62,FE,3A,F2,D1,62,C5,47,3A,90,63,B8,CA,8B,63,13
56 DATA 3E,00,32,8F,63,78,C1,32,E0,55,32,2A,3C,D6,30,32,06,5A,C3,01,63,11,FE,FF,18,0D,8C
57 DATA 11,02,00,18,08,11,C0,FF,18,03,11,40,00,C5,47,3A,8F,63,B8,28,32,78,32,8F,63,D5,2A
58 DATA DD,21,6E,55,3A,06,5A,3D,B7,28,08,47,11,08,00,DD,19,10,FC,D1,DD,73,06,DD,72,07,5E
59 DATA 06,14,3E,05,32,08,5D,C5,ED,5F,32,07,5D,CD,EB,5C,C1,10,F4,C1,C3,01,63,00,00,DD,39
60 DATA 21,6E,55,3A,07,5A,47,DD,7E,00,B7,20,10,DD,5E,04,BD,56,05,21,54,55,C5,01,03,00,12
61 DATA ED,B0,C1,11,08,00,DD,19,10,E3,C9,DD,21,6E,55,3A,07,5A,47,DD,7E,00,B7,C2,4A,64,4E
62 DATA DD,6E,04,DD,66,05,DD,5E,06,DD,56,07,19,11,F6,55,CD,39,0A,F2,E2,63,CD,54,64,C3,16
63 DATA 4A,64,11,B5,59,CD,39,0A,FA,F1,63,CD,54,64,C3,4A,64,C5,E5,06,03,7E,FE,80,28,08,00
64 DATA CD,54,64,E1,C1,C3,4A,64,23,10,F0,E1,06,0F,11,F6,55,CD,39,0A,28,12,C5,06,3E,13,73
65 DATA 10,FD,C1,CD,39,0A,28,06,13,13,10,EB,18,07,CD,54,64,C1,C3,4A,64,C1,ED,5B,3C,5C,A4
66 DATA CD,39,0A,FA,44,64,ED,5B,3A,5C,CD,39,0A,F2,44,64,CD,5A,64,C3,4A,64,DD,75,04,DD,69
67 DATA 74,05,11,08,00,DD,19,05,C2,BF,63,C9,3E,02,DD,77,00,C9,C5,E5,DD,7E,02,D6,30,4F,F3
68 DATA 06,02,CD,82,5E,E1,3E,03,DD,77,00,DD,75,04,DD,74,05,E5,D1,DD,23,DD,E5,DD,2B,E1,38
69 DATA 01,03,00,ED,B0,3A,E0,5A,3C,32,E0,5A,3A,E1,5A,3C,32,E1,5A,C1,C9,CD,CF,5C,21,00,7E
70 DATA 52,11,C9,3D,01,30,00,ED,B0,CD,DD,5C,CD,CF,5C,21,30,52,11,CE,3D,01,24,00,ED,B0,B6
71 DATA CD,DD,5C,21,54,52,11,C0,3D,01,40,00,ED,B0,CD,DD,5C,CD,CF,5C,21,94,52,11,D7,3D,E3
72 DATA 01,12,00,ED,B0,CD,DD,5C,AF,32,0F,5A,32,10,5A,CD,40,5F,DD,21,C0,59,06,19,DD,6E,89
73 DATA 00,DD,23,DD,66,00,DD,23,36,88,10,F2,21,2A,5A,22,3E,5C,11,30,5A,21,16,56,D5,E5,46
74 DATA 21,21,5A,CD,83,61,E1,D1,3A,AA,61,FE,02,CA,49,65,D5,E5,21,29,5C,11,CD,55,01,11,61
75 DATA 00,ED,B0,E1,D1,D5,E5,CD,A9,5E,2A,3E,5C,11,7A,5A,CD,39,0A,C2,33,65,E1,D1,C3,49,AE
76 DATA 65,11,08,00,19,22,3E,5C,E1,D1,01,40,00,09,EB,01,08,00,09,EB,C3,FC,64,21,82,5A,57
77 DATA 22,3E,5C,11,89,5A,21,0A,56,D5,E5,21,5B,55,CD,83,61,E1,D1,3A,AA,61,FE,02,CA,9A,C8
78 DATA 65,D5,E5,EB,06,07,2B,10,FD,01,08,00,ED,B0,2A,3E,5C,11,D2,5A,CD,39,0A,20,05,E1,0C
79 DATA D1,C3,9A,65,11,08,00,19,22,3E,5C,E1,D1,01,40,00,09,EB,01,08,00,09,EB,C3,55,65,E2
80 DATA 01,11,00,AF,ED,42,EB,21,40,5C,01,7A,00,ED,B0,21,B6,55,11,00,3C,01,00,04,ED,B0,CB
81 DATA 3E,01,32,08,5D,3E,64,32,07,5D,01,C8,00,ED,43,11,5A,3E,28,F5,CD,09,5D,ED,4B,11,49
82 DATA 5A,C5,C5,CD,EB,5C,C1,0B,78,B1,20,F6,E1,01,05,00,AF,ED,42,22,11,5A,3A,07,5D,D6,C9
83 DATA 02,32,07,5D,F1,4F,3A,40,38,FE,01,CA,3E,66,FE,02,CA,14,67,79,3D,20,C8,DD,21,A6,7E
84 DATA 52,06,80,C5,DD,7E,00,32,BF,3F,21,81,3F,11,80,3F,01,40,00,ED,B0,C1,11,D0,07,3A,9A
85 DATA 40,38,FE,01,CA,3E,66,FE,02,CA,14,67,1B,7A,B3,20,EE,DD,23,10,D4,3A,0F,5A,FE,0A,0F
86 DATA 28,06,3C,32,0F,5A,18,C1,AF,32,0F,5A,CD,40,5F,21,A6,52,11,CE,55,01,10,00,ED,B0,8F
87 DATA 21,9E,53,11,FA,55,01,3A,00,ED,B0,21,D8,53,11,86,56,01,1F,00,ED,B0,21,F7,53,11,BC
88 DATA C4,56,01,23,00,ED,B0,21,1A,54,11,38,57,01,3E,00,ED,B0,21,58,54,11,82,57,01,29,C7
89 DATA 00,ED,B0,21,81,54,11,BB,57,01,36,00,ED,B0,21,B7,54,11,0E,58,01,10,00,ED,B0,21,FC
90 DATA C7,54,11,44,58,01,23,00,ED,B0,21,EB,54,11,CF,58,01,0E,00,ED,B0,21,DA,5A,11,10,43
91 DATA 59,01,03,00,ED,B0,21,DD,5A,11,19,59,01,03,00,ED,B0,3A,0D,5A,FE,01,CC,1E,5D,FE,5B
92 DATA 02,CC,97,5D,DD,21,F9,54,06,5B,C5,DD,7E,00,32,FE,3F,21,C1,3F,11,C0,3F,01,3F,00,6E
93 DATA ED,B0,C1,11,D0,07,3A,40,38,FE,02,28,1B,1B,7A,B3,20,F4,DD,23,10,DA,3A,0F,5A,FE,22
94 DATA 0A,28,06,3C,32,0F,5A,18,C7,3E,01,32,10,5A,3E,02,32,07,5A,01,C8,00,ED,43,08,5A,F7
95 DATA 3E,01,32,0A,5A,32,0C,5A,32,0B,5A,01,9D,59,ED,43,3C,5C,21,22,5A,36,00,11,23,5A,24
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96 DATA 01,06,00,ED,B0,CD,CF,5C,3E,31,32,3E,3C,3D,32,08,3C,AF,32,CE,5C,32,CD,5C,3E,01,0F
97 DATA 32,06,5A,AF,32,E0,5A,32,E1,5A,32,90,63,32,8F,63,32,CD,5C,21,B2,58,22,CB,5C,CD,FF
98 DATA D1,5E,FD,21,B6,59,3A,0B,5A,FE,06,F2,8E,67,FD,6E,00,FD,66,01,36,A6,23,36,8D,FD,74
99 DATA 23,FD,23,3D,20,EE,21,26,53,11,00,3C,01,08,00,ED,B0,21,2E,53,11,12,3C,01,18,00,35
100 DATA ED,B0,21,46,53,11,2C,3C,01,12,00,ED,B0,21,DA,5A,ED,5B,3C,5C,01,03,00,ED,B0,21,77
101 DATA DD,5A,ED,5B,3A,5C,01,03,00,ED,B0,CD,AB,61,21,F6,55,11,40,3C,01,C0,03,ED,B0,21,0A
102 DATA 96,53,11,1B,3E,01,08,00,ED,B0,21,0A,5A,3E,30,ED,6F,FE,30,28,02,12,13,ED,6F,12,33
103 DATA ED,6F,01,00,00,CD,60,00,21,54,55,11,1B,3E,01,0A,00,ED,B0,3A,0A,5A,FE,10,28,0A,44
104 DATA FE,18,28,06,FE,26,28,02,18,60,ED,5F,FE,7F,F2,74,68,21,36,56,06,06,C5,E5,36,BF,F9
105 DATA E5,D1,13,01,3F,00,ED,B0,E1,01,80,00,09,C1,10,EC,DD,21,F0,59,06,0B,C5,DD,5E,00,26
106 DATA DD,23,DD,56,00,DD,23,21,54,55,01,03,00,ED,B0,C1,10,EA,DD,21,6E,55,11,02,00,06,33
107 DATA 04,DD,73,06,DD,72,07,DD,73,0E,DD,72,0F,C5,01,10,00,DD,09,C1,10,EB,DD,73,06,DD,17
108 DATA 72,07,CD,AB,61,3A,0A,5A,FE,01,28,21,FE,12,CC,BC,68,FE,20,CC,BC,68,FE,28,CC,BC,F4
109 DATA 68,3A,0C,5A,FE,01,20,0B,21,7C,53,11,D3,3D,01,1A,00,ED,B0,CD,CD,62,CD,EB,61,CD,DD
110 DATA CD,62,CD,4E,5F,CD,CD,62,CD,91,63,CD,CD,62,CD,B7,63,CD,CD,62,18,B8,3A,CD,5C,FE,76
111 DATA 3C,C8,2A,CB,5C,36,AE,23,36,99,23,36,A6,23,36,9D,21,F6,55,11,40,3C,01,C0,03,ED,CA
112 DATA B0,3E,05,32,08,5D,3E,32,32,07,5D,06,05,C5,CD,EB,5C,3A,07,5D,D6,05,32,07,5D,C1,44
113 DATA 10,F1,21,54,55,ED,5B,CB,5C,01,04,00,ED,B0,2A,CB,5C,2B,22,CB,5C,21,BA,5C,11,D7,C0
114 DATA 3D,01,11,00,ED,B0,3A,CD,5C,3C,32,CD,5C,3A,CE,5C,3C,32,CE,5C,FE,05,C0,2A,CB,5C,F6
115 DATA 23,23,23,23,36,8C,AF,32,CE,5C,C9,22
```

Crazy Caverns Part 2 — The Journey's End

by Tony Crowther

If you have survived keying in the first part of Tony Crowther's exclusive game (last month's issue of *APC*), you'll be delighted to know this is the following and final instalment.

Part 11 (cont)

```
128 DATA17,17,17,17,17,17,17,17,136
500 PRINT"[CLEAR]PLEASE WAIT!"
501 FORI=0TO127:R=0:FORJ=0TO7:READA:R=R+A:POKE16384+I*8+J,A:NEXT
502 READA:IFR<>ATHENPRINT"ERROR IN"I+1:END
503 NEXT:PRINT"OK. ALL DONE!"
504 LOAD"PART12",8
```

Part 12

```
0 REMPART12:ROO2:WIZARD DEVELOPMENT LTD.
1 DATA17,17,0,0,0,0,0,0,34
2 DATA0,0,0,17,17,17,17,17,85
3 DATA17,17,17,17,17,17,17,17,136
4 DATA17,53,0,0,0,0,0,0,70
5 DATA0,0,0,0,0,0,3,0,3
6 DATA0,0,0,0,0,0,0,0,0
7 DATA0,0,0,0,0,153,144,0,297
8 DATA0,0,153,153,153,153,153,153,153,918
9 DATA68,153,153,48,9,153,153,153,890
10 DATA0,0,0,0,0,0,68,0,68
11 DATA3,0,0,0,0,0,0,0,3
12 DATA0,0,0,80,68,0,0,0,148
13 DATA0,0,0,0,0,0,0,0,0
14 DATA0,0,68,0,0,50,34,0,152
15 DATA0,48,0,68,0,0,0,0,116
16 DATA68,0,3,0,3,34,34,34,176
17 DATA34,68,0,0,0,0,68,0,170
18 DATA0,0,0,0,68,0,3,34,105
19 DATA34,34,34,0,68,0,0,48,218
20 DATA5,0,68,0,0,0,0,0,73
21 DATA80,34,34,34,3,0,0,0,185
22 DATA68,0,0,0,0,0,0,0,68
23 DATA0,0,0,0,0,0,68,0,68
24 DATA0,0,0,0,48,34,34,34,150
25 DATA0,48,0,0,68,0,0,34,150
26 DATA34,34,34,48,0,0,3,0,153
27 DATA0,34,34,34,34,0,5,0,141
28 DATA0,0,5,0,0,0,0,0,5
29 DATA0,0,0,0,0,0,0,0,0
30 DATA0,0,0,50,34,0,0,0,84
31 DATA0,0,0,0,0,0,0,0,0
32 DATA3,0,0,34,34,34,34,0,139
33 DATA3,0,0,0,0,0,0,0,3
34 DATA0,0,0,0,0,34,34,34,102
35 DATA34,0,0,0,0,48,80,0,162
36 DATA0,0,0,0,0,0,0,34,34
37 DATA68,34,3,0,0,0,0,0,105
38 DATA0,0,0,0,0,0,68,0,68
39 DATA0,0,0,0,0,0,0,0,0
40 DATA0,0,0,34,34,34,34,48,184
41 DATA3,0,0,0,0,34,34,34,105
42 DATA34,0,0,0,3,34,34,34,139
43 DATA34,34,34,17,17,17,17,17,187
44 DATA17,17,17,0,0,0,0,0,51
45 DATA0,0,0,0,17,17,17,17,68
46 DATA17,17,17,17,17,17,17,17,136
47 DATA17,17,16,0,0,0,5,0,55
48 DATA0,0,0,0,0,128,0,1,129
49 DATA16,0,0,0,0,0,0,0,16
50 DATA0,0,0,128,0,1,16,0,145
51 DATA0,0,0,0,0,0,0,0,0
52 DATA0,17,17,129,16,0,48,0,227
53 DATA3,0,0,48,0,3,0,16,70
54 DATA0,129,16,22,102,102,102,102,575
55 DATA102,102,102,102,97,16,0,1,522
56 DATA16,16,68,0,0,0,0,0,100
57 DATA0,0,0,17,17,17,16,0,67
58 DATA68,0,0,0,0,0,0,0,68
59 DATA0,0,0,1,16,0,68,153,238
60 DATA153,153,153,153,153,153,144,0,106
2
61 DATA0,1,24,16,68,0,0,0,109
62 DATA0,0,0,0,0,0,0,1,1
63 DATA16,16,68,0,0,5,0,0,105
64 DATA80,0,5,0,0,81,16,16,198
65 DATA68,144,0,9,0,0,144,0,365
66 DATA9,0,0,145,16,17,17,51,255
67 DATA51,51,51,51,51,51,51,51,408
68 DATA51,49,16,0,0,0,0,0,116
69 DATA0,0,0,0,0,0,0,1,1
70 DATA16,0,0,0,0,0,0,0,16
71 DATA0,5,0,0,0,1,24,16,46
72 DATA0,0,0,0,0,0,0,0,0
73 DATA0,0,0,1,24,25,153,153,356
74 DATA153,137,153,153,152,153,153,136,1
190
75 DATA153,145,24,16,0,0,0,0,338
76 DATA0,0,0,0,0,0,0,1,1
77 DATA24,128,0,0,0,0,0,0,152
78 DATA0,0,0,0,0,81,24,128,233
79 DATA0,0,0,0,0,0,0,0,0
80 DATA0,0,0,1,17,17,0,0,35
81 DATA0,0,0,0,0,0,0,0,0
82 DATA0,1,16,8,0,0,0,0,25
83 DATA0,0,0,0,0,0,0,1,1
84 DATA16,8,8,136,136,136,136,136,712
85 DATA136,136,136,136,136,129,17,1
86 DATA17,49,49,49,49,49,49,49,360
87 DATA49,49,49,49,0,0,0,0,196
88 DATA0,0,0,0,0,17,17,17,51
89 DATA17,17,17,17,17,17,17,17,136
90 DATA17,17,17,16,0,0,0,0,67
91 DATA0,0,0,0,0,0,0,0,0
92 DATA1,16,0,0,0,0,0,0,17
```

```
93 DATA0,0,0,0,0,0,1,16,17
94 DATA0,0,153,153,153,153,153,153,918
95 DATA153,153,0,0,1,16,0,0,323
96 DATA68,51,52,51,67,51,67,68,475
97 DATA0,0,1,16,0,0,68,68,153
98 DATA68,68,68,68,68,68,0,0,408
99 DATA1,16,0,68,68,68,68,68,357
100 DATA68,68,68,68,68,68,1,16,425
101 DATA68,68,68,68,68,68,68,68,544
102 DATA68,68,68,68,1,16,68,68,425
103 DATA68,68,68,68,68,68,68,68,544
104 DATA68,68,1,16,68,69,68,68,426
105 DATA84,68,68,68,68,68,67,51,542
106 DATA1,16,68,68,68,68,68,68,425
107 DATA68,68,68,68,68,68,1,16,425
108 DATA68,68,68,68,68,68,68,68,544
109 DATA68,68,68,68,1,16,51,51,391
110 DATA68,68,68,68,68,68,68,64,540
111 DATA0,68,1,16,68,68,68,68,357
112 DATA68,68,68,69,68,64,0,68,473
113 DATA1,16,68,68,68,68,68,68,425
114 DATA68,68,68,68,68,68,1,16,425
115 DATA68,80,0,68,68,68,68,68,488
116 DATA68,68,68,68,1,16,68,68,425
117 DATA68,68,51,51,51,67,51,52,459
118 DATA68,68,1,16,68,68,68,68,425
119 DATA80,0,68,68,68,68,51,68,471
120 DATA1,21,68,0,4,68,0,0,162
121 DATA68,68,68,68,80,68,1,16,437
122 DATA0,0,4,68,68,68,68,68,344
123 DATA68,68,0,68,1,24,128,68,425
124 DATA68,68,68,68,68,68,68,67,543
125 DATA68,68,1,16,0,68,68,68,357
126 DATA68,68,68,68,68,68,68,68,544
127 DATA1,16,0,0,0,0,0,0,17
128 DATA48,0,0,0,0,0,0,1,17,66
500 PRINT"[CLEAR]PLEASE WAIT!"
501 FORI=0TO127:R=0:FORJ=0TO7:READA:R=R+
A:POKE1740B+I%8+J,A:NEXT
502 READA:IFR<>ATHENPRINT"ERROR IN"I+1:E
ND
503 NEXT:PRINT"OK. ALL DONE!"
504 LOAD"PART13",8

READY.
```

Part 13

```
0 REMPART13:ROO3:WIZARD DEVELOPMENT LTD.
1 DATA119,119,119,119,119,119,22,102,838
2 DATA102,102,102,102,17,0,0,0,425
3 DATA0,0,0,0,0,0,17,17,34
4 DATA17,17,17,17,17,17,17,17,136
5 DATA17,17,17,17,16,0,0,0,84
6 DATA0,0,0,0,0,0,0,0,0
7 DATA0,1,16,5,0,0,0,0,22
8 DATA0,0,0,0,0,0,0,1,1
9 DATA16,0,0,0,0,0,0,0,16
10 DATA0,0,0,0,0,1,16,0,17
11 DATA0,0,0,0,0,0,0,0,0
12 DATA0,0,0,1,16,0,0,0,17
13 DATA0,0,0,0,0,0,0,0,0
14 DATA0,1,34,34,0,0,0,0,69
15 DATA0,0,0,0,0,0,0,153,145,298
16 DATA24,136,0,131,136,136,136,136,835
17 DATA136,136,56,0,136,129,24,88,705
18 DATA0,136,136,56,136,136,131,136,867
19 DATA136,0,133,129,24,136,0,136,694
20 DATA136,136,136,136,136,136,136,0,952
21 DATA136,129,24,136,0,136,136,136,833
22 DATA131,56,136,136,136,0,136,129,860
23 DATA24,136,0,136,136,136,136,136,840
24 DATA136,136,136,0,136,129,24,136,833
25 DATA0,136,136,136,136,136,136,136,952
26 DATA136,0,136,129,24,136,0,136,697
27 DATA136,88,136,136,133,136,136,0,901
28 DATA136,129,24,136,0,136,136,136,833
29 DATA136,136,136,136,136,136,0,136,129,945
30 DATA24,136,0,136,136,136,136,136,840
31 DATA136,136,136,0,136,129,24,131,828
32 DATA0,136,136,136,136,136,136,136,952
33 DATA136,0,56,129,19,48,0,102,490
34 DATA102,102,102,102,119,119,119,119,0,782
35 DATA3,129,16,0,0,0,0,0,148
36 DATA0,0,0,0,0,0,0,1,1
37 DATA21,0,0,0,0,0,0,0,21
38 DATA0,0,0,0,0,81,16,0,97
39 DATA0,0,0,0,0,0,0,0,0
40 DATA0,0,0,1,16,0,0,0,17
41 DATA0,0,0,0,0,0,0,0,0
42 DATA0,1,16,0,51,0,0,0,68
43 DATA0,0,0,0,0,51,0,1,52
44 DATA17,17,17,17,17,17,17,17,136
45 DATA17,17,17,17,17,17,0,0,102
46 DATA0,0,0,0,0,0,0,17,17
47 DATA17,17,17,17,17,17,17,17,136
48 DATA17,17,17,17,17,16,80,0,181
49 DATA0,0,0,0,0,0,0,0,0
50 DATA0,0,1,16,0,0,0,0,17
51 DATA0,0,0,0,0,0,0,0,0
52 DATA1,16,0,0,0,0,0,0,17
53 DATA0,0,0,0,0,0,1,16,17
54 DATA34,0,34,0,34,0,34,0,136
55 DATA34,0,34,0,1,16,0,0,85
56 DATA0,0,0,0,0,0,0,0,0
57 DATA0,0,1,16,0,0,0,0,17
58 DATA0,0,0,5,0,0,9,153,167
59 DATA145,16,0,34,0,0,34,0,229
60 DATA0,0,0,0,0,0,1,16,17
61 DATA0,0,0,0,0,0,0,0,0
62 DATA0,0,0,0,1,16,80,0,97
63 DATA0,0,0,0,0,34,0,0,34
64 DATA0,5,1,16,0,0,0,34,56
65 DATA0,0,0,0,0,0,0,0,0
66 DATA1,16,34,0,0,0,0,0,51
67 DATA0,0,0,34,0,0,1,16,51
68 DATA0,0,0,0,0,80,0,0,80
69 DATA0,0,0,0,1,16,0,0,17
70 DATA0,0,0,0,0,0,0,0,0
71 DATA0,34,1,16,80,0,0,34,165
72 DATA0,0,0,0,0,0,0,0,0
73 DATA1,16,0,0,0,0,0,0,17
74 DATA0,34,5,0,0,34,1,16,90
75 DATA0,0,0,0,0,0,0,0,0
76 DATA0,0,0,0,1,16,0,0,17
77 DATA34,0,0,34,0,0,0,0,68
78 DATA0,34,1,16,0,0,0,0,51
79 DATA0,0,0,0,0,0,0,0,0
80 DATA1,16,34,0,0,0,0,0,51
81 DATA0,0,34,0,0,34,1,16,85
82 DATA0,0,0,0,0,0,0,0,0
83 DATA0,0,0,0,1,16,0,51,68
84 DATA0,0,0,0,0,0,0,0,0
85 DATA0,0,1,16,0,51,51,51,170
86 DATA51,51,51,51,51,51,51,51,408
87 DATA49,17,17,17,17,17,17,17,168
88 DATA17,17,17,17,17,17,17,0,119
89 DATA0,0,0,0,0,0,0,0,0
90 DATA17,17,17,17,17,17,17,17,136
91 DATA17,17,17,17,17,17,16,0,118
92 DATA0,5,0,0,0,0,0,0,5
93 DATA0,0,0,1,16,0,0,0,17
94 DATA0,0,0,0,0,0,0,0,0
95 DATA0,1,16,0,0,0,0,0,17
96 DATA0,0,0,0,0,0,0,1,1
97 DATA16,0,0,3,0,0,0,0,19
98 DATA48,0,0,1,0,1,16,102,168
99 DATA102,102,102,102,102,102,102,102,8
16
100 DATA102,97,0,1,16,0,0,0,216
101 DATA0,80,0,0,0,0,0,9,89
102 DATA153,145,16,0,0,0,0,48,362
103 DATA0,0,0,48,0,0,0,1,49
104 DATA23,119,119,119,119,119,119,119,8
56
105 DATA119,119,119,119,119,1,16,0,612
106 DATA0,0,0,0,5,0,0,0,5
107 DATA0,0,0,1,16,0,48,0,65
108 DATA0,0,3,0,0,0,0,48,51
109 DATA0,1,16,102,102,102,102,102,527
110 DATA102,102,102,102,102,102,102,97,8
11
111 DATA16,0,0,5,0,0,0,0,21
112 DATA80,0,0,0,0,0,1,16,0,97
113 DATA0,3,0,0,0,0,0,48,0,51
114 DATA0,0,0,1,23,119,119,119,119,381
115 DATA119,119,119,119,119,119,119,119,
952
116 DATA119,1,16,0,0,0,0,0,80,216
117 DATA0,0,0,5,0,0,0,0,1,6
118 DATA16,0,0,0,0,0,48,0,0,64
119 DATA0,3,0,0,0,0,1,16,102,122
120 DATA102,102,102,102,102,102,102,102,
816
121 DATA102,102,102,97,16,0,0,0,419
122 DATA0,0,0,0,0,0,0,0,0
123 DATA0,1,23,119,119,119,119,119,619
124 DATA119,0,0,0,0,0,0,1,120
125 DATA16,6,102,102,102,102,102,102,634
126 DATA102,102,102,102,102,97,16,1,624
127 DATA17,17,17,17,17,17,17,17,136
128 DATA17,17,17,17,17,16,1,68,68,221
500 PRINT"[CLEAR]PLEASE WAIT!"
501 FORI=0TO127:R=0:FORJ=0TO7:READA:R=R+
A:POKE18432+I%8+J,A:NEXT
502 READA:IFR<>ATHENPRINT"ERROR IN"I+1:E
ND
503 NEXT:PRINT"OK. ALL DONE!"
504 LOAD"PART14",8

READY.
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Part 14

```
0 REMPART14:ROO4:WIZARD DEVELOPMENT LTD.
1 DATA68,68,68,68,68,68,68,68,544
```

```
2 DATA68,17,17,17,68,68,68,68,391
3 DATA68,68,68,68,68,68,68,17,493
4 DATA0,0,0,0,0,0,0,0,0
5 DATA0,17,17,17,17,17,17,17,119
6 DATA17,17,17,17,17,17,17,16,135
7 DATA0,0,0,0,0,0,0,0,0
8 DATA0,0,0,0,1,21,0,0,22
9 DATA0,0,0,0,0,0,0,0,0
10 DATA0,0,1,16,0,0,0,0,17
11 DATA0,0,0,0,0,0,0,0,0
12 DATA1,16,0,0,0,0,0,0,17
13 DATA0,0,0,0,0,0,1,16,17
14 DATA0,0,0,0,0,0,0,0,0
15 DATA0,0,0,0,1,25,144,0,170
16 DATA9,144,0,9,144,0,9,0,315
17 DATA0,17,17,21,0,0,0,0,55
18 DATA0,0,0,0,144,0,1,17,162
19 DATA17,16,0,0,0,0,0,0,33
20 DATA0,9,0,0,17,17,17,25,85
21 DATA144,0,9,144,0,9,153,144,603
22 DATA0,1,17,17,17,21,0,0,73
23 DATA0,0,0,0,0,0,0,17,17
24 DATA17,17,17,16,0,0,0,0,67
25 DATA0,0,0,0,1,17,17,17,52
26 DATA17,25,144,0,9,144,0,9,348
27 DATA153,0,17,17,17,17,17,21,259
28 DATA0,0,0,0,0,0,0,1,1
29 DATA17,17,17,17,17,16,0,0,101
30 DATA0,0,0,0,0,17,17,17,51
31 DATA17,17,17,25,144,0,9,144,373
32 DATA0,9,1,17,17,17,17,17,95
33 DATA17,21,0,0,0,0,0,0,38
34 DATA17,17,17,17,17,17,17,16,135
35 DATA0,0,0,0,0,1,17,17,35
36 DATA17,17,17,17,17,25,144,0,254
37 DATA9,144,0,17,17,17,17,17,238
38 DATA17,17,17,16,0,0,0,0,67
39 DATA1,17,17,17,17,17,17,17,120
40 DATA17,16,0,0,0,0,17,17,67
41 DATA17,17,17,17,17,17,17,16,135
42 DATA0,0,0,0,0,0,0,0,0
43 DATA0,0,0,85,1,16,0,0,102
44 DATA0,0,0,0,0,0,0,0,0
45 DATA0,0,1,17,17,17,17,17,86
46 DATA17,17,17,17,17,17,17,17,136
47 DATA17,0,0,0,0,0,0,0,17
48 DATA0,0,0,0,0,0,0,0,0
500 PRINT"[CLEAR]PLEASE WAIT!"
501 FORI=0TO47:R=0:FORJ=0TO7:READA:R=R+A
:POKE19456+I*8+J,A:NEXT
502 READA:IFR<>ATHENPRINT"ERROR IN"I+1:E
ND
503 NEXT:PRINT"OK. ALL DONE!"
504 LOAD"PART15",8

READY.
```

Part 15

```
0 REMPART15:JUMP:WIZARD DEVELOPMENT LTD.
1 DATA0,1,0,1,1,1,0,1,5
2 DATA1,1,1,1,1,1,1,1,8
3 DATA1,1,1,1,1,1,1,1,8
4 DATA1,1,1,1,1,1,1,1,8
5 DATA1,1,1,1,1,1,1,0,7
6 DATA1,0,1,0,1,255,1,255,514
7 DATA1,255,1,255,1,255,1,255,1024
8 DATA1,255,1,255,1,255,1,255,1024
9 DATA1,255,1,255,1,255,1,255,1024
10 DATA1,255,1,255,0,255,1,255,1023
11 DATA1,255,0,255,1,255,1,255,1023
12 DATA0,255,1,255,255,0,255,0,1021
13 DATA255,0,255,0,255,0,255,0,1020
14 DATA255,0,255,0,255,0,255,0,1020
15 DATA255,0,255,0,255,0,255,0,1020
16 DATA254,255,0,255,0,255,0,255,1274
17 DATA0,255,0,255,0,255,0,255,1020
18 DATA0,255,0,255,0,255,0,255,1020
19 DATA0,255,0,255,0,255,0,255,1020
20 DATA0,255,0,255,0,255,0,255,1020
21 DATA0,255,0,255,0,255,0,255,1020
22 DATA0,255,0,255,0,255,0,255,1020
23 DATA0,255,0,255,0,255,0,255,1020
500 PRINT"[CLEAR]PLEASE WAIT!"
501 FORI=0TO22:R=0:FORJ=0TO7:READA:R=R+A
:POKE33800+I*8+J,A:NEXT
502 READA:IFR<>ATHENPRINT"ERROR IN"I+1:E
ND
503 NEXT:PRINT"OK. ALL DONE!"
504 LOAD"PART16",8

READY.
```

Part 16

```
0 POKE53248+24,29:POKE53269,0:GOSUB400
10 POKE53280,6:POKE53281,8:PRINT"[CLEAR]


":POKE53281,6
11 POKE831,0:POKE54296,15
12 PRINT"[HOME][DOWN]"TAB(32)"[WHITE]SCO
RE"
13 PRINTTAB(32)"[BLACK]000000":GOSUB230
14 ME=3:P=1
15 POKE53250,40:POKE53251,226
16 PRINT"[HOME][DOWN][DOWN][DOWN][DOWN]"
TAB(32)"[WHITE]MEN":PRINTTAB(32)"[BLACK
]0"


17 SYS50420
18 SYS49349
20 REM START
30 POKE53248+22,24
40 POKE53282,12
50 POKE53283,1:POKE49865,0
60 SYS49152:POKE1256,ME+47
80 POKE53285,0:SYS49500
90 POKE53286,1
100 POKE53287,10:POKE50461,0
110 SYS50790:POKE53278,0
120 SYS50515
130 A=PEEK(50461):IFA=255THEN200
135 GOSUB220:IF(E/10000)=>PTHENME=ME+1:P


=P+1
140 ME=ME-1:IFME=0THEN280
150 GOTO20
200 SYS51024:LE=PEEK(831)+1:IFLE>9THENLE
=0


210 POKE831,LE:GOTO20
220 E=0:FORI=0TO5:E=E*10:E=E+PEEK(1136+I
)-48:NEXT:RETURN
230 FORI=0TO5:FORJ=0TO3:IFA(J+1)>A(J)THE
NT=A(J):A(J)=A(J+1):A(J+1)=T
240 NEXT:NEXT
250 PRINT"[HOME][DOWN][DOWN][DOWN][DOWN]
[DOWN][DOWN][DOWN]"TAB(31)"[WHITE]HI-SCO
RE[BLACK]"
260 FORI=0TO4:PRINTTAB(31)A(I):NEXT


270 RETURN
280 IFE>A(4)THENA(4)=E
290 POKE53281,8:PRINT"[CLEAR]":POKE53281
,6
300 POKE53269,3:POKE53250,168:POKE53251,
204:SYS51093
310 PRINT"[WHITE][DOWN][DOWN][DOWN][RIGH


T][RIGHT][RIGHT][RIGHT][RIGHT][RIGHT][RI
GHT]YOUR SCORE IS "E:PRINT"[RIGHT][RIGHT
][RIGHT][RIGHT][RIGHT][RIGHT][RIGHT]#"
320 POKE53282,1:PRINT"[DOWN][DOWN][DOWN]
[DOWN][DOWN][DOWN][DOWN][DOWN][DOWN][DOW
N][DOWN][DOWN][DOWN][DOWN][DOWN][DOWN]"T
AB(18)"[c 1][s A][s B][s A][s B][DOWN][L
EFT][LEFT][LEFT][LEFT][s A][s B][s A][s
B][DOWN][LEFT][LEFT][LEFT][LEFT][s A][s
B][s A][s B][HOME]


330 POKE53248,168:POKE53249,100:POKE2040
,144:R=1324:G=100:POKE2041,128
340 IF(GAND7)=2THENPOKER,97:R=R+40
350 G=G+2:POKE53249,G:IFG<210THEN340
360 GOTO0
400 PRINT"[CLEAR]":POKE53280,0:POKE53281
,0


410 PRINT"[DOWN][WHITE]WELCOME TO T.C
MJINE BY A.CROWTHER"
420 PRINT"                          #
430 PRINT"YOUR MISSION IS TO CLEAR ALL
THE MJINES";
440 PRINT"#"
450 PRINT"OUT. YOU HAVE THREE LIVES TO P
LAY WITH"
460 PRINT"     #                    ^
  #
```

```
470 PRINT"YOU GET 200 POINTS FOR EACH LE
TTER"
480 PRINT"#    [          ^
490 PRINT"PLUS BONUS POINTS
500 PRINT"^              ^
510 PRINT"EXTRA MJAN EVERY 10,000 POINTS
520 PRINT"                #          ^
530 PRINT"USE 'Z' AND 'X' AND 'SHIFT'
540 PRINT"[DOWN]OR JOYSTICK PORT 2"
550 PRINT"    \ #          ^
560 PRINT"[DOWN][DOWN]      PRESS SCACE B
AR TO PLAY GAMJE"
570 PRINT"    ^                        ^  # [
580 GETA$:IFA$<>" "THEN580
590 RETURN

READY
```

Part 17

```
0 POKE53280,0:POKE53281,0
1 POKE53248+24,29
2 PRINT"[CLEAR]SAVER : THIS W!ILL SAVE T
HE PROGRAM]
3 PRINT"                                ^  [
4 PRINT"TO DISC : PLEASE W!AIT "



5 PRINT"          ^"
6 N1$="@:DATA1":N2$="@:DATA2"
7 DIV=8:PRINT"SAVING DATA1":PRINT"      [
8 POKE250,0:POKE251,32:POKE780,1:POKE781
,DIV:POKE782,1
9 SYS65466:FORI=1TO7:POKE839+I,ASC(MID$(
N1$,I,1)):NEXT
10 POKE780,7:POKE781,72:POKE782,3:SYS654
69
11 POKE780,250:POKE781,0:POKE782,153:SYS
65496:PRINT"SAVING DATA2":PRINT"      ["
12 POKE250,0:POKE251,192:POKE780,1:POKE7
81,DIV:POKE782,1
13 SYS65466:FORI=1TO7:POKE839+I,ASC(MID$
(N2$,I,1)):NEXT
14 POKE780,7:POKE781,72:POKE782,3:SYS654
69
15 POKE780,250:POKE781,0:POKE782,207:SYS
65496
16 PRINT"ALL DONE."
READY.
```

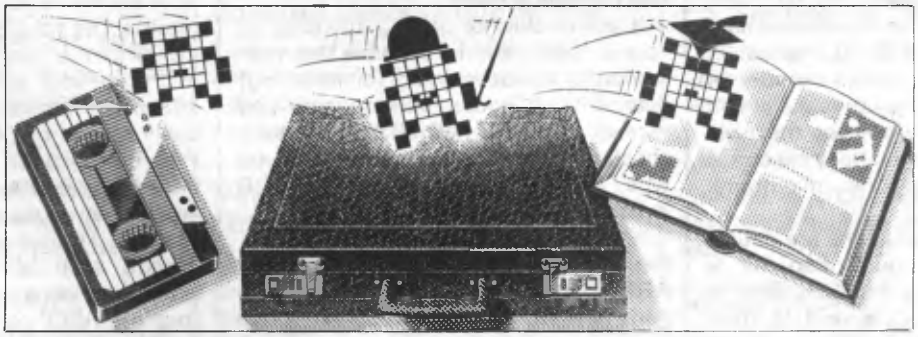
Part 18

```
1 A=A+1
2 IFA=1THENLOAD"DATA1",8,1
3 IFA=2THENLOAD"DATA2",8,1
4 POKE56,32:PRINT"[CLEAR]LOAD"CHR$(34)"P
ART16"CHR$(34)",8
5 POKE198,2:POKE631,19:POKE632,131:NEW
READY.
```

Crowther correction

Gremlins crept into the end of Part four of our Tony Crowther listing in last month's issue. The following lines should replace the ones in the listing.

```
501 FOR I=0 TO 70:R=0: FOR J=0 TO 7:
READ A: R=R+A: POKE 9216+ I*8+J,A:
NEXT
502 READ A: IF R<>A THEN PRINT
"ERROR IN" I+1: END
503 NEXT: PRINT "OK. ALL DONE!"
504 LOAD "PART5",8
```



APC is interested in programs written in any of the major programming languages for all home and small business micros. When submitting programs please include a cassette or disk version of your program, brief but comprehensive documentation, and a listing on plain white paper — typed if you have no printer.

Please ensure that the software itself, the documentation and the listing are all marked with your name, address, program title, machine (along with any minimum requirements) and — if possible — a daytime phone number.

All programs should be fully debugged and your own original, unpublished work.

We prefer to receive programs with a maximum 80-column width printed in emphasised typeface.

Please keep a copy of everything.

Programs are paid for at the rate of $20 per page of published listing.

Send your contributions to APC Programs, 77 Glenhuntly Road, Elwood, Victoria 3184.

Dial-an-answer

Peter Tootill and Steve Withers reveal the common symptoms of problem RS232 interfaces.

ComputerPhone

Telecom's new ComputerPhone is an interesting development. The concept of combining the busy executive's telephone-answering machine, micro, calculator and mainframe terminal in one unit looks like becoming the way of the future. It would also make a nice addition to any online computer user's equipment.

However, we don't believe that it will really take off as a terminal-to-mainframe system when it has to be used via a modem over a telephone line — and at a pedestrian 1200 bits/sec too. Most existing computer users will be using terminals connected on high-speed hard wired links running at 9600 bits/sec. If they were to install a large number of ComputerPhones, they would need racks of modems to answer the calls from the aforementioned busy executive wanting to access the mainframe system.

The hardware implications are daunting and security could also be a headache. Some organisations like to strictly control dial-up access to their computers, and this would be a problem if they had to consider a large number of ComputerPhone users.

However, if Telecom offer a module that will enable the ComputerPhone to act as a hard-wired terminal as well as a stand-alone micro, then it will probably sell in large numbers to such customers.

RS232 troubleshooting

If you're having problems using online systems, there are a number of common symptoms which will give you a clue as to where to look for the cause and cure. Here are the most common cases:

Nothing seems to happen: check that your modem and the one you have called have locked together. Has your modem's carrier detect (CD) light come on? If not,then you are probably calling a system that has incompatible modem standards — Viatel with a 300 bits/sec modem, for example. Try a different system, or change the settings on your modem if it's a multi-standard type. Most systems operating in Australia are V.21 (300 bits/sec) or V.23 (1200/75 bits/sec). Most bulletin boards use V.21, Viatel uses V.23. Some systems provide both, either on separate numbers or by automatically detecting your mode when you call.

If the CD light comes on but nothing appears on your screen, try sending a few carriage returns.

If you're still not getting anything on your screen, then it's possible that your computer is not sending (or receiving) data. If your modem has transmit and receive data (TD and RD) indicators, check that the TD one flickers when you type at the keyboard. Is the RD indicator flickering?

If you don't have TD and RD indicators, the easiest way to check that your computer is transmitting and receiving properly is to set your modem to test mode (sometimes called 'analogue loop') if it has this facility. If it doesn't you can test the computer and RS232 interface by connecting the transmit and receive pins together (pins 2 and 3 on a standard 25-way connector).

In both these cases, with a terminal program running and set to full duplex, whatever you type on the keyboard should be echoed back to the screen. If not, it could be connection problems — are pins 2 and 3 the right way round? Alternatively, perhaps the lack of a control signal is stopping the computer from transmitting. Some software needs to see CD go high before it will start to send.

Try different software or investigate the state of the various pins with a voltmeter. A 6- or 9-volt battery can be used to set the various control lines high or low.

Garbled data: if you are receiving badly, or completely, garbled data when online, the most likely cause is incompatible word length and/or parity settings. The most common settings are 8-bit word, no parity, one or two stop bits, and 7-bit word, even parity, one or two stop bits. The number of stop bits is not as critical as the word length.

Another cause of garbled data is a poor phone line. In this case, you will often get letters appearing when nothing is actually being sent; this is caused by noise on the line.

Missing characters at the start of a line: this is most likely to be caused by your system needing nulls after carriage returns. The solution, for BBSs at least, is to look for the command that enables you to change your terminal configuration.

Missing chunks of text: this is probably caused by flow control problems. When information is being sent to you from an online system, there may be times when your computer needs time to catch up. This is especially true at higher speeds, such as 1200 bits/sec. The usual way to pause output is to use a couple of ASCII control characters called X-on and X-off (the 'X' stands for 'transmission'). If you lose chunks of data, it's probably because your system is overloaded with incoming data and is not sending an X-off character to request the sender to pause. Alternatively, it may be sending X-off and the sender doesn't recognise it, but this is unlikely, as most online systems support X-on/X-off flow control. X-off is control-S (ASCII decimal 19), X-on is control-Q (ASCII decimal 17).

Everything sent to you appears on one line: this happens when your system needs a line feed after a carriage return and isn't getting one. Most systems have the facility to provide line feeds.

The system won't accept your password: if it won't, even though it has done so before, check that you are sending the correct case. Many systems see

upper and lower case as different, and it's easy to get it wrong when the system doesn't echo it back to you.

Access Controls

Whether it is due to vandalism or simply too many users, many BBSs are placing restrictions on access. The most common control is to deny access to those who are not members or subscribers, although in many cases "visitors" can use a small subset of the facilities provided. The problem of having too many users is also being tackled by restricting users to twenty or thirty minute sessions.

To save "wasted" calls, we will be adding access control information to our listings as it becomes available. One or two letters will appear after the system's phone number — "P" for public access and "M" for members, possibly with a "V" for visitor access. Thanks to Greg Conroy for the suggestion, and for details of some new systems.

BULLETIN BOARDS

Australian systems

Micro Design Lab RCPM

Telephone: (02) 663 0150 (P). System Operator: Stephen Jolly. Hours: 5pm–7am weekdays. 24 hours weekends.

MI Computer Club BBS

Telephone: (02) 662 1686 (MV). System Operator: Evan McHugh. Program downloading. Hours: 24 hours daily.

Sydney Public Access RCPM

Telephone: (02) 808 3536 (MV!). System Operators: Barrie Hall and David Simpson. Membership required. Hours: 24 hours daily.

Prophet RBBS

Telephone: (02) 628 7030 (P). Operator: Larry Lewis. Hours: 24 hours daily.

TISHUG BBS

Telephone: (02) 560 0926 (MV). System Operator: Shane Anderson. Hours: 7pm–7am weekdays, 24 hours weekends.

AUGABBS

Telephone: (02) 451 6575 (MV). System Operators: Mathew Barnes and Andrew Riley. Hours: 24 hours daily.

AUSBOARD

Telephone: (02) 955 377 (P). System Operator: Daniel Moran. Hours: 24 hours daily.

CLUB-80 RTRS

Telephone: (02) 332 2494 (MV). System Operator: Michael Cooper for Sydtrug. Hours: 24 hours daily.

OMEN I

Telephone: (02) 498 2495 (P). System Operator: Ted Romer. Hours: 4.30pm–9am weekdays, 24 hours weekends.

ORACLE

Telephone: (02) 960 3641 (P). System Operator: Rowan Evans. Hours: Midnight–8am weekdays, Midnight–6am weekends.

INFOCENTRE

Telephone: (02) 344 9511 (MV). Hours: 24 hours daily.

Dick Smith Electronics RIBM

Telephone: (02) 887 2276 (P). System Operator: Ian Lindquist. Program downloading. 24 hours daily.

Sorcerer Users Group RCPM

Telephone: (02) 387 4439 (MV). System Operator: John Woolner. Hours 6pm–8am weekdays, 24 hours weekends. Ring back system.

Newcastle Microcomputer Club RCPM RBBS

Telephone: (049) 68 5385 (MV). System Operator: Tony Nicholson. RBBS free to all, RCPM for members only ($4/year, PO Box 293, Hamilton, NSW 2303). Hours: 5pm–8.30am weekdays, 24 hours week-ends.

Date BBS

Telephone: (02) 550 1004 (MV). System Operator: Steven Williams. Hours: 9am–11pm weekdays, 24 hours weekends. Computer dating.

Keeboard TBBS

Telephone: (02) 631 3282 (P). System Operator: Phillip Keegan. Hours: 6pm–8.30am daily.

RUNX Unix System

Telephone: (02) 487 2533 (MV). System Operator: Mark Webster. Hours: 24 hours daily. Call (02) 48 3831 for system status.

Tesseract RCPM

Telephone: (02) 651 1404 (MV) System Operator: John Hastwell-Batten. Hours: 24 hours daily.

Tomorrowland's DIRECT

Telephone: (02) 411 2053 (MV). System Operator: Mike Kidson. Hours: 24 hours daily. Helpline: (02) 412 3909.

Canberra RBBS

Telephone: (062) 88 8318. Hours: 24 hours daily.

MICOM RCPM CBBS

Telephone: (03) 762 5088 (MV). System Operator: Peter Jetson. Hours: 24 hours daily.

Melbourne PIE

Telephone: (03) 878 6847 (P). System Operator: Len Gould. Hours: 24 hours daily.

Sorcerer Computer Users Association CBBS

Telephone: (03) 434 3529. System Operator: David Woodberry. Program downloading for SCUA members. Hours: 24 hours daily.

PC Connection IBBS

Telephone: (03) 528 3750. System Operator: Lloyd Borrett. IBM PC program downloading. Hours: 24 hours daily.

OMEN IV

Telephone: (03) 846 4034. System Operator: Philip Westh. Hours: 24 hours daily.

HiSoft IBBS

Telephone: (03) 799 2001. System Operator: Richard Tolhurst. IBM PC program downloading. Hours: 24 hours daily.

Computers Galore IBBS

Telephone: (03) 561 8497. System Operators: Bob Cooban and Martin Scerri. IBM PC program downloading. Hours: 24 hours daily.

East Ringwood RCPM

Telephone: (03) 870 4623. System Operator: Mick Stock. Hours: 4pm–midnight Monday-Friday ONLY.

Gippsland RCPM

Telephone: (051) 34 1563. System Operator: Bob Sherlock. Hours: 24 hours daily.

Mail-Bus

Telephone: (051) 27 7245. System Operator: Max Moore. Person-to-person mail. Multi-player games and bulletin board coming. Membership required for virtually all facilities. Write to M Moore, PO Box 234, Newborough, Vic 3825. Hours: 24 hours daily.

Software Tools RCPM

Telephone: (07) 378 9530. System Operator: Bill Bolton. Program down-loading. Hours: 24 hours daily.

Adelaide Micro User Group BBS

Telephone: (08) 271 2043. Hours: 10am–10pm, weekends and public holidays. 9am–9pm weekdays.

Computer Ventures CBBS

Telephone: (08) 255 1946. System Operator: Daniel Schumacher. Hours: 24 hours daily.

Omen II

Telephone: (089) 27 4454. System Operator: Terry O'Brien. Hours: 24 hours daily.

Outback RCPM

Telephone: (089) 27 7111. System Operator: Phill Sampson. Hours: 24 hours daily.

OMEN III

Telephone: (09) 279 8555. System Operator: Greg Watkins. Hours: 24 hours daily.

New Zealand systems

NZ Micro Club RBBS

Telephone: 0011 64 9 762 309. System Operator: Chris Cotton. Hours: 24 hours daily. Software up/down-loading. Type "help" to log in.

Peripheral Selector — 2 way $155 postpaid complete with all cables (2m long) serial or parallel — up to 5 way available.
KENT DESIGN, 27 ARTHUR ST
Nth Caulfield, 3161. Ph: (03) 509 8751

Overseas systems

North America

SYSTEM	*NUMBER*	*NOTES*
SPACE Citadel	0011 1 206 839 4759	
Ckcms Citadel	0011 1 206 329 0436	
Eskimo North Minibin	0011 1 206 527 7638	
Conn-80	0011 1 212 441 3755	TRS-80 Color Computer
CLEO	0011 1 213 618 8800	Job vacancies
Mindstorm Network	0011 1 812 235 0908	Networked BBSs

EUROPE

ELFA ABC-MONITOR, Sweden	0011 468 730 0706	Half Duplex
ABC-Banken, Sweden	0011 463 511 0771	
ABC-MONITOR, Sweden	0011 468 801 523	Password required
CBBSD Gothenburg	0011 463 129 2160	75/1200 baud
CBBS Sweden*	0011 463 169 0754	
BUG, Sweden	0011 468 463 528	BBC Micro
XD-BBS Helsinki	0011 358 072 2272	
Commodore BBS, Finland	0011 358 116 223	
Tedas, Munich	0011 49 89 596 422	
Decates, Germany	0011 49 66 154 51433	

UK

CBBS South West	0011 44 626 890 014	
Liverpool Mailbox	0011 44 51 428 8924	
BASUG	0011 44 742 667 983	
Computer Answers	0011 44 1 631 3076	
CBBS Surrey	0011 44 4862 25174	
Blandford Board	0011 44 258 54494	
Microweb TBBS	0011 44 61 456 4157	BBC Micro
Stoke Information Technology Centre RCPM	0011 44 782 265 078	
Clinical Notes Online	0011 44 254 60339	

Africa

Connection 80, Cape Town	0011 27 21 457 750
TRShop, Cape Town	0011 27 21 5367
Peters Computers, Johannesburg	0011 27 11 834 5134
Peters Computers, Johannesburg	0011 27 11 834 5135
War Games, Johannesburg	0011 27 11 642 3722

* After receiving the tone and connecting your modem, either type <C/R> or <COM C/R>. The system then asks for a password which is 'cbbs' in ***lower-case*** letters. If you only get a '>' from the system, it needs resetting, so type <I> C/R.

This information is correct and current to the best of our knowledge. Please send corrections and updates to: Steve Withers, C/- *Australian Personal Computer*, 77 Glenhuntly Road, Elwood, Victoria 3184.

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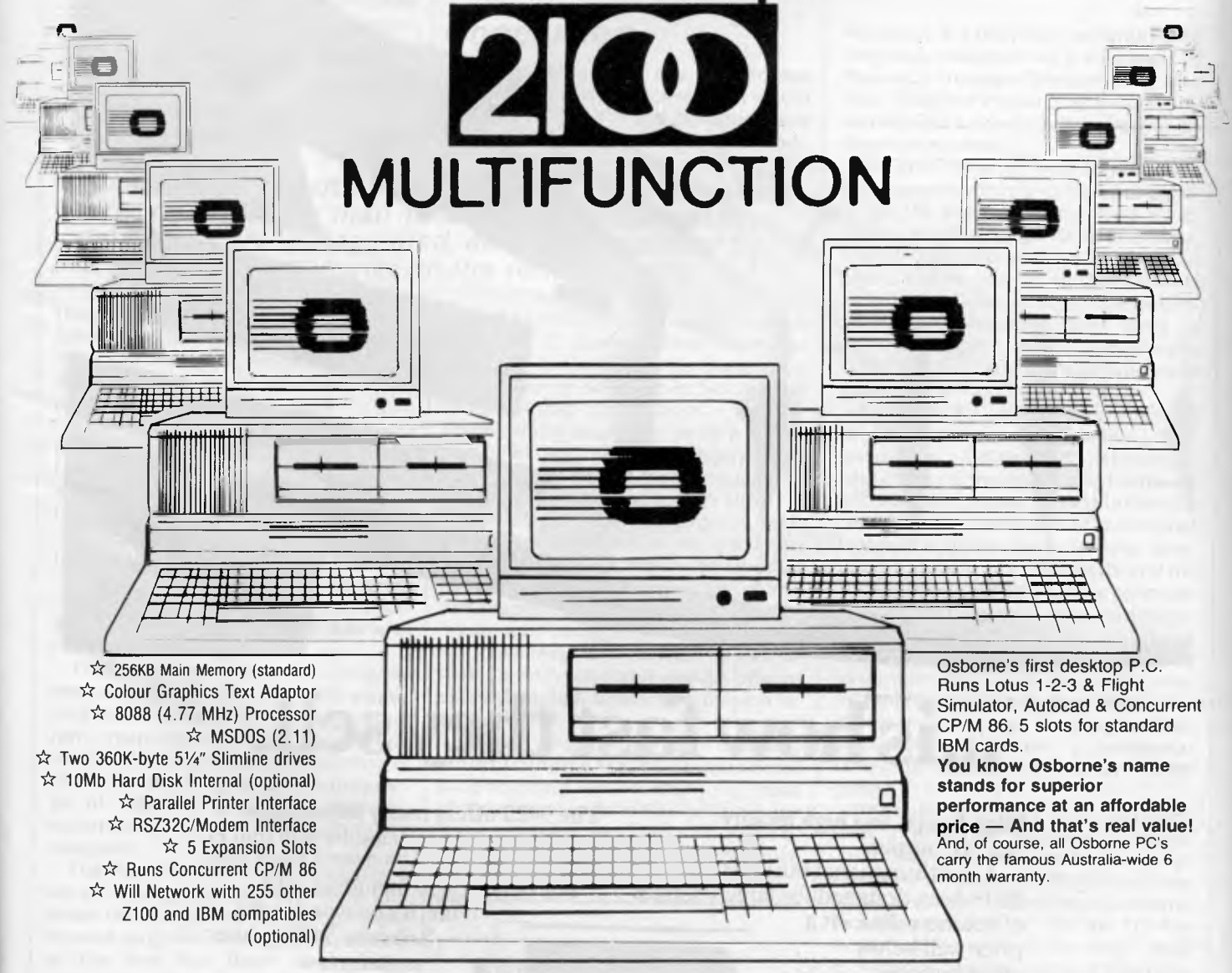

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Mind your language

Continued from page 42

no immediately obvious links are available to the pull-down menus and icon design, which limits Basic in terms of large, system-like applications.

The sound commands are less essential. The SOUND statement has parameters for Pitch, Amplitude and Duration. Easy access to Ptolemy's diatonic scale (A,B,C,D,E,F and G) is provided by the TONE command which returns corresponding pitch values.

With all this programming power provided from Basic there's usually one thing that suffers — speed. Even with a full-blown 68000 I was convinced that it would be below par. Not so, because of the way Mac-Basic translates your program into a runnable form.

Mac-Basic hangs on to the 'interpreted' label by the skin of its teeth. Lines are tokenised upon entry, as with any good Basic. However, selecting RUN from the aforementioned Program menu results in the program being further compiled down (see the Benchmarks in Fig 2). The Benchmarks are more than acceptable for a version of Basic, and encroach into the realms of Pascal and Forth.

Further commands on the Program menu are GO and HALT, which resume and stop execution of a running program respectively; RUN ANOTHER, which allows simultaneous running of either multiple copies of one program or of different programs; and the opportunity to save the binary form of a program.

The Program menu also contains a set of debugging options. When you enter the debugger, a tracing finger follows program execution by moving to the line that Basic is currently executing. There are three tracing modes: Step, to single-step the program; Trace, which runs the program at normal speed with the tracing finger; and the most useful, Block Trace, which lets you trace at full speed within control blocks and one line at a time outside control blocks. Although the finger (graphically drawn complete with shirt cuff and jacket) looks rather like a gimmick, it's useful when you're debugging programs.

Another option, Show variables, creates a window called Variables and displays the names of all the simple variables in the program, and their current values, while the program is running.

Conclusion

Although Mac-Basic has its heritage within the Basic environment, it would be unfair to call it just another Basic dialect. I have reservations about calling it Basic at all: it seems as though a group of C programmers have got together and created the Basic they would like to see. Apple has turned programming languages upside-down: while Mac-Basic is very nearly compiled and very fast, Mac-Pascal (usually a compiled fast language) is interpreted and consequently slow.

Previously I've only considered Basic as a prototype tool to try out ideas before converting them to another language. Mac-Basic is not only ideal in this respect; but could also be used to implement something more serious. My only reservations are the lack of menu control and icon design (Microsoft's Macintosh Basic has provision for these).

Overall, Apple has done an excellent job in turning the Macintosh into a Basic programming environment. If more companies were to follow suit, perhaps Basic programmers might be cured of their bad habits and start to produce structured, understandable code.

'Mac scores over other dialects of Basic in its data typing. No fewer than 10 different fundamental data types are incorporated, each distinguished by a terminating character on the variable name . . .'

Benchmarks

BM1	0.24
BM2	0.65
BM3	6.00
BM4	6.4
BM5	7.1
BM6	8.6
BM7	15.9
BM8	52.3
Average	12.15

Fig 2

Modula-2 is a high-level programming language designed as a successor to Pascal by Professor Niklaus Wirth, who also designed Pascal. It is particularly suitable for systems programming on small computers.

In 1970, Professor Wirth formulated a new programming language, principally for the purpose of teaching structured programming. This language, Pascal, became widely known and used, thanks mainly to the portable so-called p-Code (Pascal code) implementations, resulting from work at Professor Wirth's Institut für Informatik (at ETH Zürich) and at the University of California at San Diego (UCSD).

However, Pascal was never intended to be a systems programming language and it deliberately discouraged knowledge of the underlying hardware and operating system. Its use in this role required the inclusion of additional features and was never entirely satisfactory. During the 1970s Wirth and his colleagues worked on further concepts in programming languages, particularly in systems programming which has traditionally been the domain of assembler (low-level) languages, and in expressing the concepts of concurrency in high-level languages. This work resulted in the experimental language Modula ('MODUlar LAnguage').

Although Modula-2 was designed with a particular machine in mind, 'Lilith', it is also an appropriate programming language for most machines and is available for a variety of systems including the IBM PC. On the PC, the system can be run free-standing — that is, without needing support from the IBM's operating system. On the XT model, and optionally on the PC, Modula-2 is run on top of the operating system and can access data produced by programs in other languages. It is especially suitable for systems-level programming but has significant advantages over Pascal for applications programming.

Modula-2 offers advantages over Pascal in four distinct areas:
Modern syntax — the BEGIN and END

compound statements of Pascal have been replaced by the notion of a statement sequence and each structured statement has an explicit terminator — END. The CASE statement has an ELSE-part, as does the variant record.

There is no GOTO statement but instead a LOOP...EXIT...END statement, RETURN for premature quitting of a procedure (or module) and a HALT statement. Further small improvements have been made on Pascal in many areas of the language.

Modules — the module is a new device for structuring programs. It adds to the familiar hierarchical block structure and forms the basis for a method of separate compilation which retains full type-checking across separate program texts, unlike the traditional *independent* compilation schemes of Fortran and C.

The module as a compilation unit allows complex operations (including all input-output) to be supplied in library modules, provided either by implementors or software houses, or by users themselves.

Low-level facilities — unlike Pascal, it's possible to take advantage of details of the machine, but unlike the C programming language this access is made explicit and can even be denied by implementations if required.

Concurrency — Modula-2 offers a low-level device for concurrent programming in the form of the 'coroutine'. This simple device allows more sophisticated synchronisation facilities to be programmed as needed. The source code of a scheduler based on 'signals' is presented in Professor Wirth's book as a practical example of the use of coroutines, and this forms the body of one of the library modules.

One of the main difficulties with high-level languages is their relatively poor portability. Even Pascal suffers, despite the recent ISO standard. It also frequently needs sections to be written in low-level language due to its restricted areas of application. This use of low-level code limits portability further.

Modula-2 offers improvements in several ways:

(1) The language is defined by a thirty-page document called *Report on The Programming Language Modula-2* which forms part of Professor Wirth's book on the language — *Programming in Modula-2*. Although this document is too informal in style to be ideal for implementors, it's very readable and is therefore of value to the ordinary programmer.

(2) Unlike Pascal, modifications to the language made by implementors must be reported to ETH Zürich. Implementors are working with Professor Wirth to agree on improvements and to agree the content of the library modules, which form an essential part of every implementation. Fortunately, there is a high degree of cooperation in these areas and within MODUS — the Modula-2 Users' Association.

(3) The module facility of the language allows system details to be hidden from the normal, applications-level programmer and, although library modules may be implemented differently from one machine to another, they can all present a consistent interface to the programmer.

The package consists of the:

Compiler. This generates an intermediate code (p-Code) which must then be interpreted. Unfortunately, Volition has implemented the language with a one-pass compiler. This approach is quite suitable for Pascal, which was designed to make one-pass compilation natural, but does not work well for Modula-2. In particular, it upsets Modula-2's rules of scope and also necessitates a change to the language (the directive FORWARD must be used with mutually recursive procedures — as in Pascal).

Otherwise, the compiler conforms well to Wirth's report. There are no apparent omissions, and extensions are available only on the inclusion of a compiler directive. Certain differences in implementations can be attributed to the somewhat informal style of Wirth's report which leaves certain points unclear. Volition understands the spirit of the language well and appreciates the value of minimising the number of extensions or differences.

The major extension is the retaining of the concept of a *packed* data-structure from Pascal. This is the only mechanism which allows the programmer control over the representation of data in the machine, but there is disagreement as to whether or not this facility should be incorporated in the language. Fortunately, Volition's extensions can be used only if a compiler directive is given, so the programmer who likes to keep programs standard should not get confused.

A small implementation requirement is the inclusion of the SEG loader directive in definition modules. The DIV and MOD operators do not work for variables of type CARDINAL (non-negative integers) when the values exceed the maximum integer. This does not sound serious but it has upset one of my programs and limits the usefulness of the type CARDINAL.

The most recent minor changes to the language have not yet been incorporated, but this is not surprising and I know of only one implementor who has so far made all the changes.

One standard extension (used by Wirth for the Lilith) is the possibility of including low-level language instructions in a so-called 'code procedure'. In this implementation the low-level language can be either p-Code or the IBM PC machine code. This facility can be used to overcome to some degree the disadvantages of interpretative code in time-critical sections of programs.

Modula-2 Library. The module concept and separate compilation make it possible for the Modula-2 language to be very simple. For example, there are no statements for input and output in the language; procedures for accomplishing these operations must be *imported* from standard modules. Although the language permits primitive input/output operations to be programmed, in terms of interrupts, input ports, and so on, the normal programmer will not wish to do this. Wirth has defined a small number of standard modules for this and similar purposes which have been implemented by Volition.

The following four types of modules are supplied:

Library — as defined by Wirth in his book. Implemented by Volition except those relating to high-resolution raster graphics, windows and mice. Later to be extended to include those agreed by implementors and by MODUS.

System-dependent — in this case those particular to Volition and the p-system. Volition has devised a set of file control and input/output routines which will be common to all implementations. These will eventually be replaced by a standard set of modules, after discussion among implementors and MODUS.

My only dislike is Volition's tendency to offer operations as functions which return a value indicating the degree of success. This is a style of programming more appropriate to an expression-based language such as C and is

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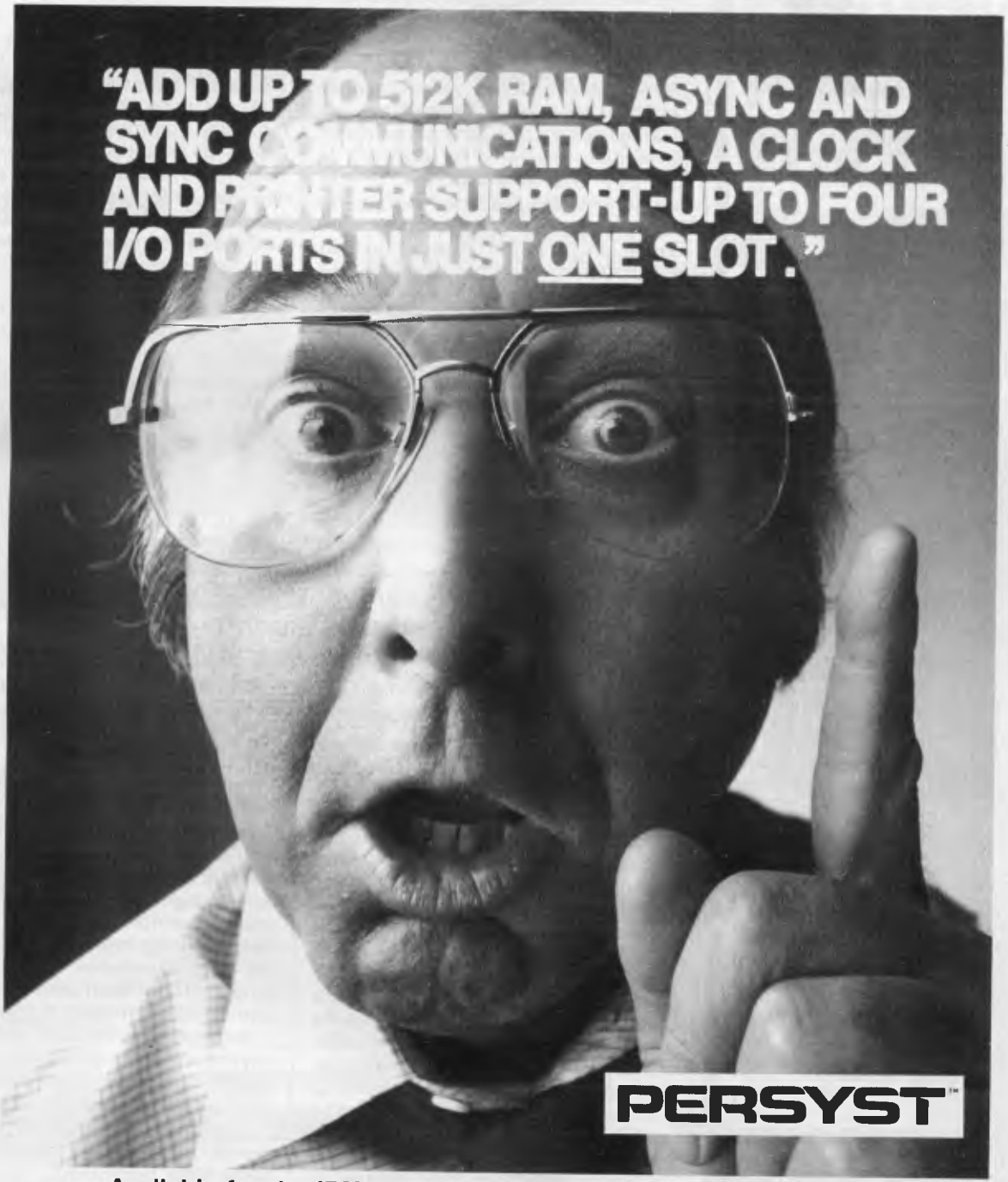

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unnatural in Modula-2. I prefer functions to be used for evaluation of a result only, and for operations to be performed by procedures. For example: *function* IsOpen returning TRUE or FALSE and *procedure* Open to cause the file to be opened.

Machine-dependent — modules IBM-Stuff and SYSTEM86 pertain directly to the IBM PC, in particular they relate to low-level facilities. These supplement the (standard) facilities offered in all implementations by the module SYSTEM.

User-defined — those constructed by particular users for their own purposes.

Linking loader. One of the pleasures of developing programs in Modula-2 is the way that management of the component modules is done for you by the system. You can use a module library, similar to the library of units in UCSD. During program development you don't need to use libraries: linking is done dynamically and version checking is performed rigorously by the system. For example, it is possible to put together a small modular program consisting of a main module and a subsidiary module very simply. The subsidiary module must, by the rules of the language, be composed of two separate source files, called the *definition* module and the *implementation* module. The definition describes *what* facilities are offered by the module to its clients, and the implementation states *how* the facilities are implemented. It follows that the implementation module can be changed without necessitating a recompilation of its clients, as long as it does not conflict with its former definition.

'The user who is very much concerned with speed may be bothered by the interpreted nature of the implementation, but, to a certain extent, the code procedure can overcome this problem.'

The system ensures that the definition module is compiled before either its clients or its implementation. The process of editing an implementation module, recompiling it and running the suite again, is much faster and safer than the equivalent in older languages.

UCSD p-system. This is very similar to the operating system on other machines such as the Apple II.

Advanced System Editor (ASE). This is an improvement on the normal p-System editor with additional facilities. The ASE can handle large text files by automatically swapping data in and out of memory, and it allows the user to define special 'function keys'. It can display catalogue information so that you can move from editing one file to another without having to quit the editor, enter the Filer, request a listing of the volume and then return to the editor. I found this facility very useful, as is the possibility of displaying the first line of each file.

Pascal compiler (VS). VS Pascal is a dialect of standard Pascal with many UCSD features but not including UNITs.

'p-nix' shell. A useful facility of (most implementations of) Modula-2 is the possibility to call up another program 'on top of' an existing program. This makes it possible to write command language interpreters, or shell programs, as simple Modula-2 programs. This implementation includes a Unix-like shell, unfortunately named 'p-nix'. It includes the better-known Unix utilities and can be extended by the user. It also includes 'I/O redirection' and 'pipes'.

RAM disk. When using a machine with large amounts of random-access memory (RAM), parts of this memory can be designated to appear to programs to be a disk. This means that data normally handled slowly on the disk is handled very quickly on the RAM disk. It is important to remember, however, that the RAM disk is volatile. Unlike a real disk, of course, its contents disappear when you turn the power off, so you need to remember to make copies on to a real disk.

The documentation includes a copy of *Programming in Modula-2* by Niklaus Wirth which includes the *Report on the Programming Language Modula-2*. The *Report* is the definitive document on the language, and the book includes several example programs which illustrate the programming of graphics and the Lilith computer. This is a well-produced book but it's not intended as a tutorial for beginners.

However, it should be possible for anyone with a reasonable knowledge of Pascal to master the syntax of the language in a few hours.

In addition, there are several documents produced by Volition which come in a fashionable, small-format binder. These are: the *Modula-2 User's Manual* — an introduction to the sections that follow; the *Introduction to Modula-2* — this is essentially for Pascal programmers and includes good ex-

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amples contrasting Pascal and Modula-2. It concentrates on those areas of Modula-2 which will be new to Pascal programmers, such as modules, procedure variables, coroutines; *Standard library* — this is the text of the definition modules with explanations of some of the modules prescribed by Wirth (InOut, RealinOut, Terminal, Storage, Program, Processes) and those defined by Volition, which are standard across their implementations of Modula-2 on a range of machines (Texts, Reals, Files); the *Utility library* — this includes Wirth's MathLibO (sin, cos, and so on) and Volition's Decimals, Strings, Conversions, ASCII. I am not quite sure of the distinction between 'standard' and 'utility' in this context. One small complaint is Volition's technique of documenting a type as if it is *opaque* (its structure is not visible to the client) when it is in fact visible. Although this is done for a good reason, it confused my understanding of opaque types; the *Modula-2 on the UCSD Pascal system* — this covers the library system, the compiler and how to use the system. It includes compiler directives for listings, non-standard features and half-ASCII keyboards; the *Modula-2 Operating System* — this covers the batch command interpreter (used to automate repetitive system tasks), the shell command interpreter ('p-nix'), the file manager, the Pascal compiler, the utility programs; the *Modula-2 on the IBM PC* — this document shows where the IBM PC version differs from the others and how Modula-2 interacts with the IBM's operating system. It includes machine representations of data types and definitions of modules IBMStuff and SYSTEM86, and the module Wides which gives access to the IBM's 8087 coprocessor; the *ASE User's Manual*; and *Example Programs* — these are provided on disk and are designed to demonstrate aspects of the language. Each one contains documentation in the form of a comment and can be compiled and run.

The documentation is well-produced and comprehensible. It has been produced using the ASE and a 'SPRINTER-2' text formatter. The advantage of this is a relative scarcity of typographical errors.

A small objection is the placing of the indexes at the end of each section. This is obviously very convenient to the writers, but does make it hard to find sections until you are familiar with the structure of the manuals.

Volition's documentation has a tendency to imply that certain of its extensions are part of the standard language. These extensions include: return type of functions being any type, SET OF CHAR, and prescribing the address of a variable.

Modula-2 is an excellent programming language for implementing software on small systems such as the IBM PC. It offers all the benefits of Pascal with the flexibility of C (without sacrificing security), and without the complexity of Ada. It's easy for a Pascal programmer to learn the syntax of Modula-2.

Volition Systems' Modula-2 is a well-engineered implementation of the language with only minor points that would upset a purist. On the whole it keeps to the spirit of the language, unlike many implementations of Pascal. In addition to the language, you get the Unix-like shell, the Advanced System Editor and a practical library.

The user who is very much concerned with speed may be bothered by the interpreted nature of the implementation, but, to a certain extent, the code procedure can overcome this problem.

If you use other machines for which Volition implements Modula-2 (for example, Apple II, Sage), then you will probably value the portability that Volition's modules give across this range. In any case, the portability of Modula-2 across all implementations is relative and will improve as the standardisation of the library proceeds.

I am slightly bothered by the effects of the one-pass compilation, but they do not affect many of my programs. I'd have liked to get at the graphics (and a mouse) of the IBM through a convenient module (such as the Turtle-Graphics available in UCSD Pascal and in Volition's Modula-2 on the Apple 2). However, I know that the situation regarding graphics on the IBM PC is complicated, so perhaps I should not complain. I can probably do the work myself using the low-level facilities of the language. These are small complaints and I would not let them prevent me from recommending this implementation.

END

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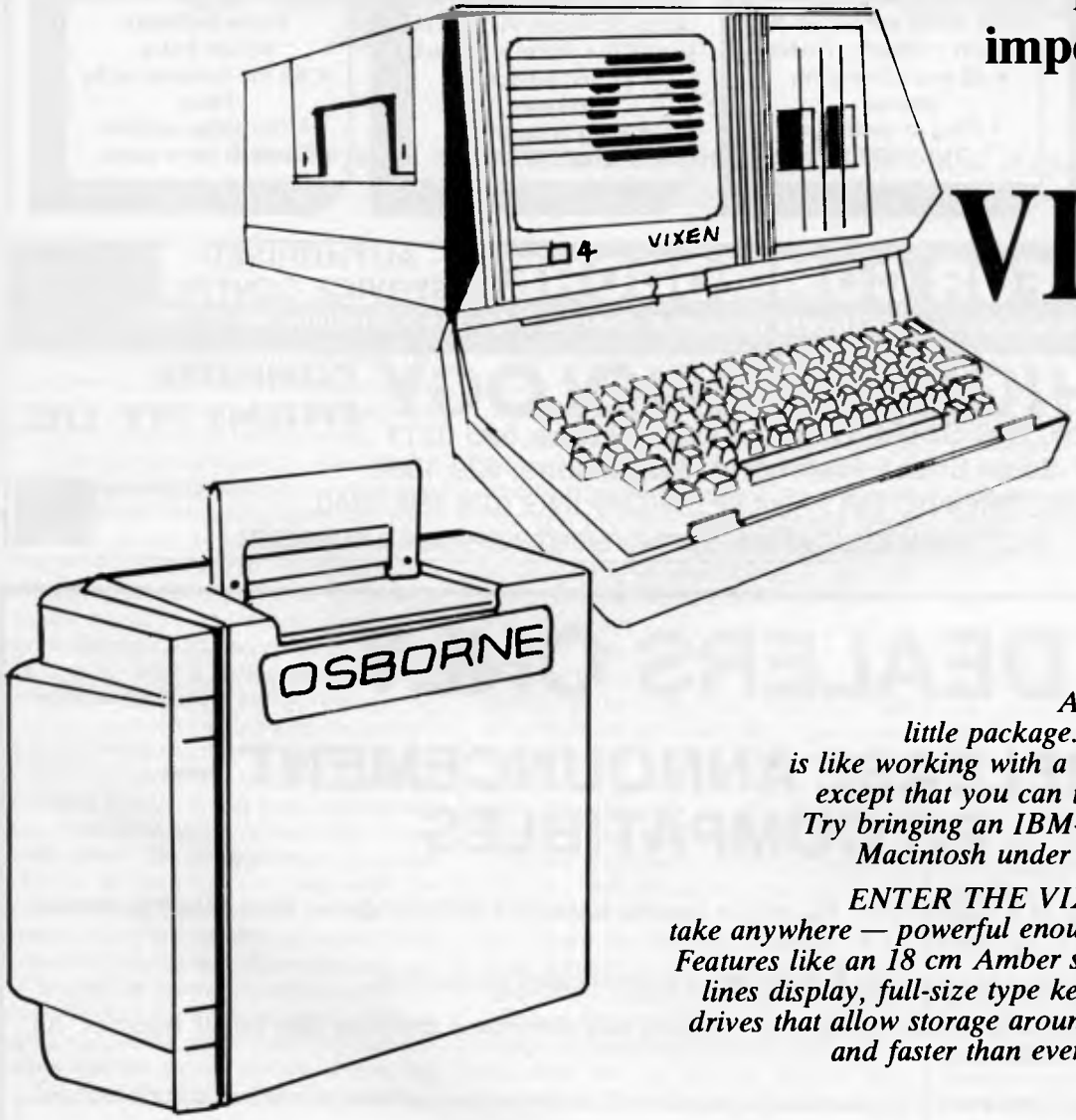

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Objective design

Brian Heywood looks at object-oriented design, a method of programming that is unusually flexible and more of a philosophy than a set of hard-and-fast rules.

Historically, new software design methods are developed to overcome increasing complexity in computer programming tasks, thus saving programmers from having an unreasonable number of nervous breakdowns.

Object-oriented design is no exception to this rule and is basically a refinement of previous methods, and, as such, includes concepts like stepwise refinement and functional decomposition. However, you don't have to know what these methods are to use the object-oriented approach, since object-oriented design is more a philosophy of design than a set of hard-and-fast rules.

The purpose of structured design is to clearly define the flow of control in a program. This is done in languages like Pascal (and Sinclair SuperBasic) by the use of procedures and function calls. These calls allow the programmer to ignore details of the program code until the code actually needs to be written. This means that the program can be designed overall to have a sensible structure, and is known as stepwise refinement. This method also gives advantages in debugging a program, since the bits that don't work will be clearly defined areas (for example, the procedure/functions, and so on).

This sounds like a good idea, but it doesn't take into account the data manipulated by the program. Many bugs are caused by accidental multiple use of the same data, or uncontrolled access to data by the various parts of the program. The first problem often occurs in Basic since all data is global, and it is quite easy to mistype a variable name, or use the same variable name in different parts of the program. The second problem occurs if the data structure of the program is complex (say, a database program) and/or if you have more than one programmer working on a particular piece of code — they're unlikely to use the data in exactly the same way. The more 'public' data is, the greater the chance of this data becoming corrupt.

Ideally we need to restrict access to the data. One way this can be done is to encapsulate the data in an 'object', and only allow the data to be altered by a small number of well-defined routines or 'operations' associated with this object.

This is the crux of the object-oriented design philosophy. By limiting access to the data we can ensure that it isn't accidentally corrupted, and if by chance this happens we know which bit of code to check for errors. Object-oriented design can be applied to solve a particular problem: for example, designing a database.

Suppose we need a database to store names and addresses. We therefore need to store a variable number of items of data (names, address, phone number, and so on) and we need to access this data. The number of things we need to do with this data is limited to a few basic actions, such as add an entry to database, alter or delete an entry. Thus we can do everything with four functions, which become our operations on the database object. More complex manipulation of the database can be described using these primitive operations: I'll use a Pascal-like pseudocode throughout the article to illustrate the example.

```
entry : RECORD
          surname
          first_names
          address
          phone_number
        END
```

Fig 1 Basic system level design

Basic design

Our basic system level design will look like this: an object called database which contains a complex data structure called data and consisting of individual entries, each called entry (see Fig 1).

This is operated on by the operations:

add_entry — add entry to end of database

get_entry — get entry from database,

change_entry — change an entry in the database

delete_entry — remove an entry from the database

Fig 2 shows this in diagrammatic form.

The main parameter for the operations add_entry, change_entry and get_entry is obviously going to be of data type 'entry'. However, we are also

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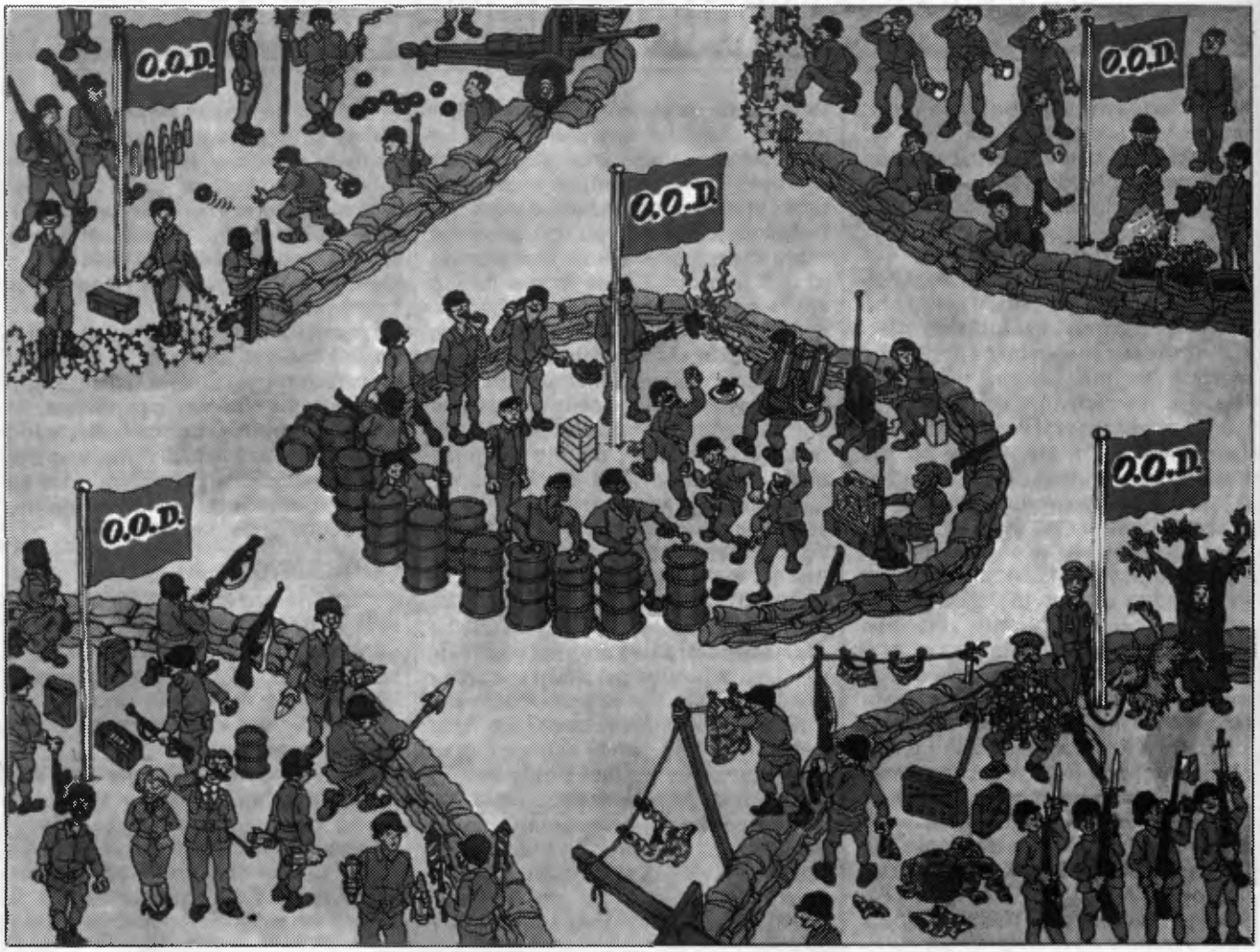

going to need some way to reference a particular entry using an index. We can write the operations followed by the parameters in brackets. For example:

add_entry(entry)
get_entry(entry, index)
change_entry(entry, index)
delete_entry(index)

where 'index' is some variable which uniquely addresses an entry in the database.

The programmer doesn't need to know what the internal structure of the database is to use it, just the composition of a single entry. This is called information hiding. Obviously the data structure has to be forumlated and the operations written at some point, but we can leave these tasks until the overall design has been completed. Furthermore, if at some later date we decide to change the internal structure of the database, we can do so as long as we keep the interface (parameters passed by the operations) to the rest of the system the same. This last point simplifies the problem of software maintenance considerably.

Using these primitive operations we can construct more complex manipulations of the database contents. Functions such as 'search', 'sort' and 'report' can be expressed as different combinations of add_entry, get_entry, change_entry and delete_entry. For example, if we wanted to access an entry by the contents of one of the fields in the entry (the surname, for instance), we could use the operations as shown in Fig 3.

However, note that entry_surname is the surname data field in 'entry', and display and input_string are general-purpose operations which belong to the VDU object.

With the example in Fig 3, you can see that the manipulated data is clearly visible at all times, as the database is only accessed through the well defined get_entry operation. This type of approach also ensures that the function of this section of code is obvious (that is,

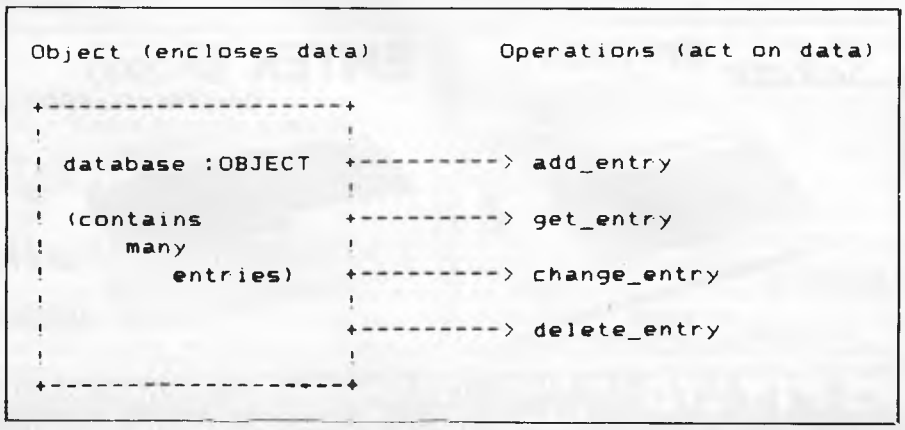

Fig 2 Database object diagram

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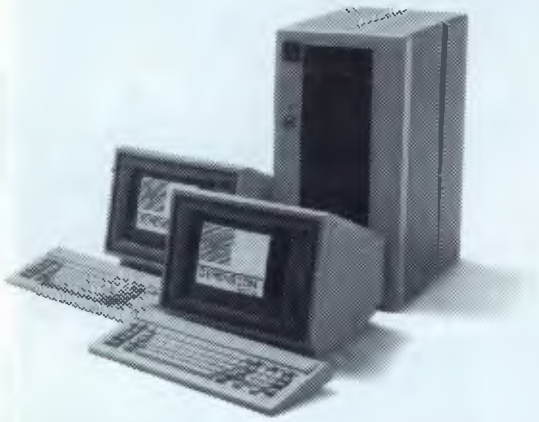

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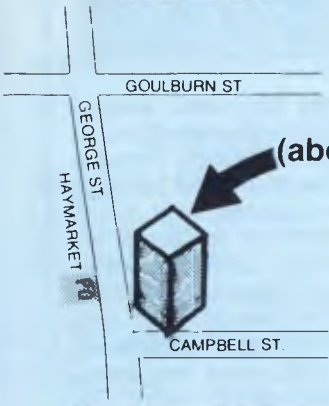

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```
initialise index ;          /* it's good practice to */

initialise entry ;          /* initialise variables */

input_string( search_name) ;  /* get the name to search on */

while not end of database do

                            /* call the  primitive operation */
     get_entry(  entry,  index) ;

     if entry.surname = search_name then display( entry) ;

     increment( index) ;

end_while
```

Fig 3 Constructing complex manipulations from primative operations

```
  repeat                        /* endless loop */

       display_menu ;    /* operations from interface object */

       input( option);

       case option of

            add_entry :

                 input_entry( entry) ;     /* provided by interface
                                                  object          */
                 add_entry( entry) ;       /* provided by database
                                                  object          */
            display_entry :

                 /* as described in example above */
                      .
                      .
                      .

            delete_name :        more functions etc .....

       end_case

  until hell_freezes_over         /* end of driver loop */
```

Fig 4 Simple driver for database program

self-documenting).

Hardware interfaces

We have at the moment only considered encapsulating data. There is no reason for not treating hardware interfaces in the same way: for example, the interface to the person using the database. In fact, this approach has definite advantages if we ever need to change the hardware on which the program is running, to a different terminal type or even to an entirely different data entry method. If we encapsulate all the user-machine operations in an object called interface, we only need to change the code in that section of the program. This has obvious advantages if you are writing programs which will eventually be run on different computers and is more flexible than just having 'device driver' code, since it encompasses the entire logical interface (which is sometimes called the man-machine interface or user interface). You could have a range of user interfaces, one which looks like Unix, another which looks like PC-DOS.

I previously referred to an operation called display (entry). This could be a general-purpose operation for displaying one entry on the VDU screen. Since the screen formatting and special control

Objective design

codes and features vary from terminal to terminal, this method for simplifying the substitution of these terminals is very useful. There are other aspects of the hardware which can be successfully placed into objects; for example, the large number of different types of mass storage device make the technique useful. If you upgrade your mass storage device from tape storage to disk you don't need to rewrite the entire program, just alter the permanent store object. An entire system can be built up from these modular objects.

The finished system closely models the real world. This means we have an object-model for each 'object' in the real world, in this case the terminal, mass storage device and the 'people' (or names and addresses) in the database. In addition, the above discussion doesn't mention the order of execution: that is, the sequential aspects of the program.

At the highest level of the design (the most abstract) all we are interested in is the data. When we get down to coding Basic allow you explicitly to show the the operations, the sequence for each individual data manipulation is going to be defined. The overall sequencing of operations in a normal single task or single user environment would be controlled by a rudimentary driver loop, which would call the various operations in the required order (perhaps from external stimulus, see Fig 4). In a multitasking and/or interrupt-driven system the task scheduler, or interrupt handlers (simple procedures called by hardware interrupts), would be used to call the operations as required. The main aim is to keep it as simple as possible.

There is no reason in theory why an object oriented-design can't be implemented in any programming language. However, in practice, some languages are more suitable than others. The more recent languages such as Modula-2 and ADA have built-in features limiting the access to variables by the rest of the program.

Pascal, C, Fortran and Sinclair Superoperation interface data (such as 'entry') as the formal parameters of procedure and function calls. Basic and assembler don't actually give you any inherent functions to help you code an object-oriented design, but do help you to produce a tidier design.

Conclusion

Object-oriented design is a tool used to deal with complexity in a large programming task. It can be applied to a problem of any size successfully. Whether the final code produced is compact or fast will still depend on the skill of the program.

Used properly, this method will reduce the time needed to write and debug a program, increase it's reliability, and will make the finished program easier to maintain and alter. Since a major cost of a computer system is writing the software, people are always looking for ways to reduce this cost. If the time taken to write a program is not important, then the increased reliability and ease of maintenance is bound to be attractive in its own right.

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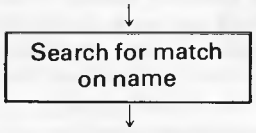
Programming style

One of the surest ways of achieving fast-running programs is to develop an individual programming style — that is, either a personal or a 'house' style. Style implies standardisation. Once you have found a good way of performing a particular program function, stick to it until you have a very good reason for changing it. This also applies to the general structure of the program. Writing the code for this function will then become second nature to you, the bugs will have disappeared long since from that section and it can be typed in almost without thinking. Build up a library of generally useful subroutines and try to give them the same and easily remembered start line number in each application. In this way, the address of the subroutines will be remembered and can be referred to in the program almost without thinking. By implication, the subroutines must be developed to have general application. Other aspects of style will appear in the structure of the program and will be described later.

There is a difference between the structure of programs in general and the structure of a particular application. The structure of a particular application arises from an analysis of the requirements. This must be done thoroughly at the start. Making changes to a 'finished' program because an important requirement was forgotten is time-consuming and may even ruin the efficient structure of the program. That is not to say that the customer's requirements will not change (with bespoke programming they assuredly will), but it is your job to anticipate the changes that might be required at a later stage and allow for their insertion when building the original application structure.

After the analysis of the requirements, construct a flow-chart of a program to meet these. Take as an example an accounts suite consisting of sales, purchase nominal ledgers together with stock control, sales analysis, ordering, invoicing, and so on; this will occupy between 20 and 25 pages of code. Without a flow-chart it is easy to lose track of where you are. Not only that, but flow-charts should be an essential part of the software documentation. As you code the program in accordance with the flow-chart, add to the block on the diagram the line number that commences the function of the block. This makes the task of tracing through the program much easier later on.



Conventional flow-chart symbols will not always cope with Basic options: ON — GOTO is an example. A multiple exit block rather than whole row of decision blocks illustrates this (see Fig 1).

Analysis

The first step, obviously, is to analyse your program's requirements before constructing a flow-chart to meet them. While constructing the flow-chart, I find it useful to design all the menus for the program (assuming that menus are to be used) because these will determine the major modules of the program and the sections of the flow-chart. Don't be afraid to redraw the flow-charts several times before you are satisfied with them. In this way all the redundant sections can be eliminated, the common subroutines highlighted and the many alternatives of achieving the desired results explored.

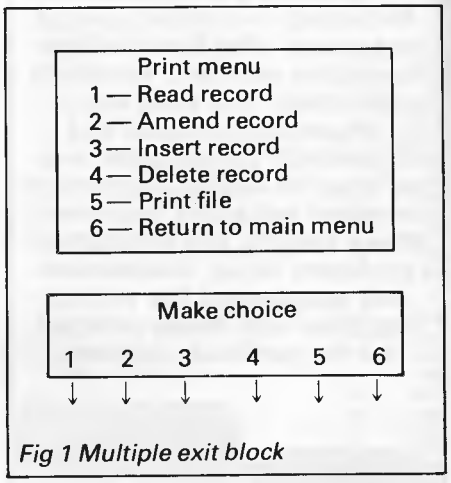


Fig 1 Multiple exit block

Strategic decisions which will affect the whole program should be made when the menus are being designed, and reviewed when the flow-chart has been completed. These decisions will include such things as: whether numeric values are single or double precision; whether values are to be held in core in a large array, or as a random file in permanent storage; whether or not the program is to be machine specific; whether each transaction is to be incorporated in the file to which it refers, or in a separate audit file, and so on.

Applying these to an accounting package example, the totals of each nominal account can be turned into a profit/loss report very quickly if these are held in a core array. The difficulty is that even a modest number of accounts — for example, 60 — together with the fact that each could have totals for cash-in-hand, cash-at-bank, and credit, for each of twelve months, will occupy 60 x 12 x 3 items. With double-precision values at 8 bytes each, the array will occupy 17k.

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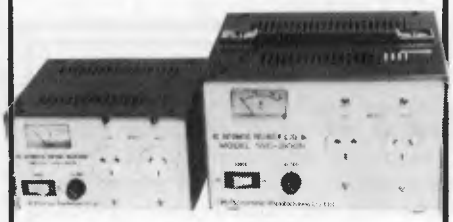

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under CP/M, then you won't get much change out of 30k for these. In a 64k memory you therefore have 34k for program and variables. I suggest that if a hard disk is available, then use random access files rather than an array. (They are roughly equivalent in that they both allow rapid selection of one set of items.)

Double precision is likely to be a must for monetary values — otherwise, with single-precision, one will be limited to a little over $30,000.00 before the cents disappear; or to $3,000.00 if rational roundings of the cents is to be retained. While double-precision variables may be individually defined throughout the program, this is tedious and the $ sign can easily be forgotten when coding. It is suggested that all variables capable of being grouped in the program should be. For example, all double-precision variables should start with B so that they may be defined with DEFDBL in a group. No reserved words in MBasic begin with B. In addition, J,Q,X,Y,Z, are useful to preface variables that are to be grouped without clashing with reserved words and for defining as single, double-precision or integers in groups. K and H can be used with care.

Memory space limitations will almost certainly force the chaining of the main program modules. Chaining is an advantage anyway, at least with MBasic where all or a choice of variables can be transferred and a start line specified. Chaining modules reinforces the structure of the application program and, if properly done, enables each module to be tested separately.

It is essential to have a correctly designed foundation module onto which the other modules overlay. This foundation module has some similarities to the environment division in COBOL but it should go further than that. The foundation module should contain:

(a) A housekeeping section to fulfil such tasks as general definition of variables and dimensioning.
(b) The definition of all the string variables and numeric constants (if any) that will be used throughout the suite of modules. For example, A$=STRING$(20,"*") as a useful heading underline, and perhaps AL$=A$+A$+A$+A$+A$ to give an across-the-screen division.

All string variable arrays that will be frequently used should also be set up at this time. They are either written into the code, or loaded into the array from a file. Account headings would be an example of these, such as: H$(1)="Rent" :H$(2)="Rates".
(c) The definition of all screen control characters. For example, MBasic doesn't include a clear screen command because this and other screen controls, such as half brilliance, field protection and cursor control are specific to the particular terminal in use. A program feeding an ICL K9 terminal would require:
CL$=CHR$(27)+CHR$(42) as a clear screen command.
(d) The definition of all printer control characteristics. Commonly used controls will be: top-of-form, $ sign, print size, underlining.
(e) The definition of common messages: for example, BAD$='Incorrect entry, please try again'. This is also set up with the screen control for flash or reverse characters as desired or determined by your style.
(f) A table of the *common* variables (those to be transferred from one module to another) if the ALL option of CHAIN is not used.
(g) The program suite heading and main menu together with choice selection.
(h) A chaining table.
(i) Commonly used subroutines.
(j) All file handling subroutines.

The layout of the foundation module is shown in Fig 2.

Examining an accounting program in detail should help to clarify the following.

The housekeeping is done by line 10:

```
10CLEAR:DIM  H$(120),  ST1$(10),
  ST2$(10), SD1$(12), F$(14)IT$(14),
  DAT$(14), T$(10), TR$(10): DEFDBL
  B: DEFINT J
```

H$() is the array to hold the nominal account headings. ST1$() and ST2$() are the fields in two stock files, one holding stock item data and the other holding stock sales data. SD1$() is the array of stock descriptors.

Housekeeping & variable definition (a to f)
Program suite heading & main menu (g)
A chaining table (h)
Subroutines (i & j)

Fig 2 Foundation module layout

Next come the string variables:

```
15  A$=STRING$(20,"*"): AL$=A$+
  A$+A$+A$+A$
20  SD1$(0)="Ref": SD1$(1)="Qty":
  SD1$(2)="Unit":  SD1$(3)="Item":
  SD1$(4)="Size" . . .
```

The definition of the 12 descriptors in the foundation module will save a lot of space in the overlay modules. For example, to show the first 11 stock details after having selected the stock number and read this record:

```
FOR  X=0  TO  10:PRINT  SD1$(X);
```

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TAB(20)ST1$(X):NEXT X is sufficient.

The screen control characters are defined in line 25:

```
25 CL$=CHR$(27)+CHR$(42): BT$=
   CHR$(27)+CHR$(73):
DEL$=CHR$(27)+CHR$(82)
```

These are a few of the screen control codes: clear screen, back tab and delete line. How these are set up depends on one of the strategic decisions — whether the program suite is to be general-purpose or specific. Give the control codes meaningful but short names like TOF$ for top-of-the-form or CL$ for clear screen. You will be using them extensively throughout the program and you won't have to keep referring to your list of variables (which you are of course, keeping as coding proceeds) because this is time-consuming. There is no need to waste memory space and typing-in time by continual use of long variable names: reserve these for when they are essential.

Grouping variables by common starting letters is another way of increasing their intelligibility.

Line 30 defines the printer control characteristics:

```
30 TOF$=CHR$(12):COM$=CHR$(15):
   UON$=CHR$(27)+CHR$(45)+CHR$
   (1): UOFF$=CHR$(27)+CHR$(45)+
   CHR$(0)
```

These are printer control codes for top-of-the-form, compressed print and underline on and off.

Line 40 is a sample common message:

```
40 TAIL$='Please pay this invoice
   before the 20th of next month.'
```

The table of common variables comes in line 80:

```
80 COMMON CL$,DEL$,A$,AL$.TAIL$,
   and so on.
```

If memory space permits, it is very much simpler to use the ALL option in the CHAIN command.

Next comes the title and main menu section:

```
100 PRINT CL$;SL$:PRINT SPC (23)
   'Company Accounting and Stock
   Control':PRINT AL$: PRINT SPC(27)
   'Copyright J.D.I.Locke 1984': PRINT
```

This is the title; SL$ clears an independent status line 25. This will later be used to show the title of the module in use. It is easy to forget which ledger is in use if you are taking a telephone call or a coffee break, especially as the menus can be similar in different sections of the program. The status line is particularly useful for this purpose as it is a non-scrolling line not affected by screen clear and is provided on many terminals. A routine follows the title to display company details and to call for input of the date which will be used throughout the

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operating session. The latter routine bristles with control codes and validation checks in order to simplify operator input and minimise operator error.

```
105 TEXT$(1)='1-Purchase Ledger':
  TEXT$(2)='2-Sales Ledger':
  TEXT$(3)='3-Nominal Ledger':
  TEXT$(4)='4-Stock Control':
  TEXT$(5)='5-End session'
110 FOR X=1 TO 5: PRINT TAB(30)
  TEXT$(X):NEXT
  X:PRINT:PRINT:KL=1:KH=5:
  GOSUB 520
```

This illustrates one simple method of getting a neat screen layout while minimising the possibility of typing errors in the coding. To obtain the main menu at any time only requires the contents of line 110. KL and KH are controls for the limit of numeric input at the line 520 subroutine. This in its simplest form could be:

```
520 REM**MENU SELECTION**
525 INPUT'Input the number re-
  quired',K
530 IF INT(K)<>K OR K<KL OR K>KH
  THEN PRINT BAD$: GOTO 525
535 RETURN
```

The basic interpreter will catch the input of a letter rather than a number. The next program line in this section will print the selected choice in the status line by extracting MID$(TEXT $(K),3,LEN(TEXT$(K))) and combining it with the necessary control code.

Lines 130-170 are the chaining table. the same line of code will contain ON K GOTO 130,140,150,160,170 where:

```
130 CHAIN MERGE "PURCH",
  1000,DELETE 1000-9999
140 CHAIN MERGE "SALES",
  1000,DELETE 1000-9999
150 CHAIN MERGE "NOM",
  1000,DELETE 1000-9999
160 CHAIN MERGE "STOCK",
  1000,DELETE 1000-9999
170 CLOSE:SYSTEM
```

Note the use of a common starting line and a common deletion range. This type of standardisation speeds the coding by making these references easy to remember. The last line, 9999, is a dummy line well past the end of program coding and is used to contain a REM of the module name. Always refer to this before saving the latest version otherwise you will find yourself overwriting another module on disk.

It can happen — just too easily. The end session is very simple in this case, merely a precautionary file closing before returning to the operating system. It is worthwhile considering backup of all the data files at this stage. Try to make this operation as automatic as possible so that there is no excuse to skip this chore. You will often find that the operating system can help considerably here. Consider the use of a SUBMIT file to link the program with backup. (It will simplify matters if the suffix .DAT is given to all the data files that need regular backup.)

File-handling

The final section covers file-handling. Generally, the files will be random access, so subroutines will be required to open the file and dimension the fields, to read a record, to write a record and to find a vacant hole in the file for a new record. To give examples of these, the supplier's account file will be used. Twenty records per month have been allocated to each of 150 suppliers, giving 3000 records. At the end of each month, or when all the allocated records have been filled, a statement is printed out and the account cleared to a single brought forward balance. SAC% is used as the record number and is calculated from the supplier reference number, SUP%. The file is called SUPPACC.DAT.

```
250 REM**OPEN SUPPACC**
255 OPEN "R",#3, "SUPPACC.DAT":
  FIELD#3,3 AS F$(0),9 AS F$(1),8 AS
  F$(2),8 AS F$(3),8 AS F$(4),8 AS
  F$(5),8 AS F$(6),8 AS F$(7),8 AS
  F$(8):RETURN
260 REM**READ SUPPACC**
265 GOSUB 250:GET#3,SAC%: CLOSE
  #3: FOR X=0 TO 8: SAC$(X)=F$(X):
  NEXT X:RETURN
270 REM**WRITE SUPPACC**
275 GOSUB 250: FOR X=0 TO 8: LSET
  F$(X)=SAC$(X): NEXT X: PUT#3,
  SAC%: CLOSE#3: RETURN
280 REM**FIND VACANT SUPPACC**
285 SAC%=SUP%*20 -19: GOSUB
  250: GET#3,SAC%: WHILE SAC%
  <SUP%*20 AND VAL (F$(0))=>1:
  SAC%=SAC%+1: GET#3, SAC%:
  WEND: LSET F$(0)= MKI$(SAC%):
  FOR X=1 TO 8:LSET F$(X)=" ":NEXT
  X:PUT #3,SAC%:CLOSE#3:RETURN
```

It should be noted that the first field contains the record number when it's occupied, otherwise it is blank. The subroutine at 280 may seem longer than is necessary as the section which writes back the record number only into the vacant record. This is a precaution to be taken in a multi-user system to reserve the vacant record as soon as it is found while the user, or another part of the program determines its contents. Without this, you could find two users both trying to grab the same record.

This is not the only precaution that has to be taken — other users should be locked out of that file or that record while it is being written to. The use of a single open statement is invaluable during program development, since only a single statement has to be altered should any

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changes to the file structure be required. The use of common file-handling subroutines does make the adaptation of the program to multi-user simple. All that is required is a jump, at the beginning of the write routines, to a test subroutine to check whether that file is in use and whether that record is in use at the moment. A jump back to the file-sharing routine is made just after the file has been closed to reset the indicators and to release the file again.

In its very simplest terms, with the files only being open for as long as required (as illustrated here) it's possible for a small multi-user system to set a single key when any file is open for writing to inhibit all other access to the files during this time. Even with three users, the resulting delay is negligible. The delay to re-read this key to see if it has been cleared after an unsuccessful attempt need only be of the order FOR X=1 TO 500:NEXT X. Although it is common practice to open all the files necessary at the beginning of the program and then to close them all at the end of a session, I prefer to close most of the files as soon as reading or writing has taken place and accept the slight loss of speed.

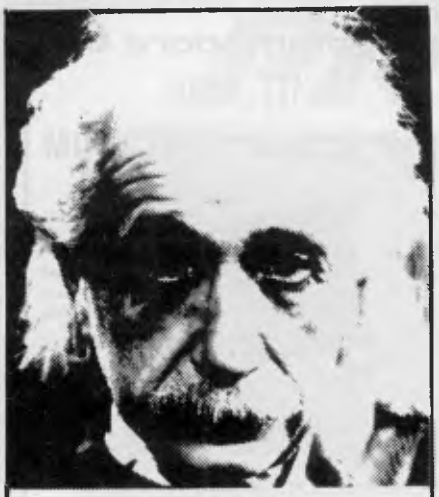
Multiple record search

An exception to the above principle is the multiple record search, an example of which is at subroutine 280; here the file is opened at the start of the search and closed at the end. The speed penalty is small and it does save the loss of all the data files when the system crashes.

As another example of multiple record search, assume that there is a file called SUPPLIER.DAT,#5, containing such details as name, address, telephone number, and so on of 150 suppliers (record 151 is a dummy). The record number is given by SUP% and the file is opened by subroutine 310. To search for a particular supplier's name (contained in field F$(2) one could use:

```
1100 TB=0:    INPUT"Name";NA$:
  GOSUB 2070: IF TB=1 THEN PRINT
  "Another try?": GOSUB 500: ON K1
  GOTO 1100, 1000, 1000
2070 GOSUB 310: SUP%=1: GET
  #5,SUP%:WHILE SUP%<151 AND
  NOT INSTR(F$(2),NA$): SUP%
  =SUP%+1: GET#5,SUP%: WEND
2080 CLOSE#5: IF SUP%>150 THEN
  PRINT"Name not found": TB=1:
  RETURN
```

Note that as the 'while' condition depends on the contents of a field, the file must be read outside as well as inside the loop. The subroutine at 500 is a standard yes/no routine returning K1=1 for



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yes, K1=2 for no and K1=3 for error. Each module starts at line 1000 with a menu display. The return must not be to a clear screen command, otherwise the message will not be displayed.

Although the above implies that all the files should be random access, sequential files are useful for reading data into an array: for example, the account headings, if they were set up in a separate program.

```
50 OPEN "I",#1, "STARDATA.DAT"
55 FOR X=0 TO 5: INPUT#1,CO$(X):
   NEXT X: INPUT#1,MI$: FOR X=0 TO
   120: INPUT#1,H$(X): NEXT X:
   CLOSE#1
```

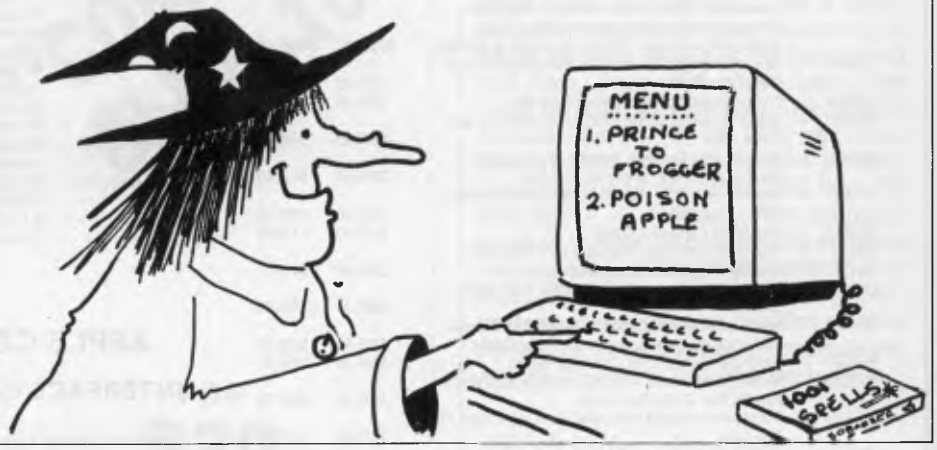
In this example, CO$(X) includes the company name and address, MI$ the first month in the financial year, and H$(X) the account headings as described before.

As mentioned, one strategic decision which must be made before program design commences is whether the program is to be machine specific or general. If the latter, then a customising module has to be written. One approach is simply to list the machine specific control characteristics required and then let other users insert the codes to match them.

Research

The other approach is for you to carry out the necessary research into the most popular terminals and printers, and to find out what control codes they will support. You then set up a multiple choice for the user to select the terminal/printer that is being used. The program transfers these specific control codes into a file which can be read by the foundation module to match the variable names that have been given to the control codes in the program. The complete set-up program need not be complex and can be covered by a page or so of code.

It is assumed, of course, that all the machines have a common operating system and carry a common Basic variant, hence the use of MBasic for the examples. I'm not a purist when it comes to the use of GOTOs. A pragmatic approach is important and good use should be made of all the tools to hand.



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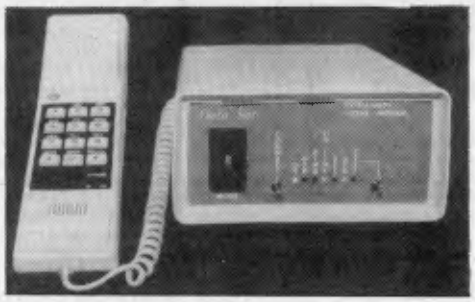

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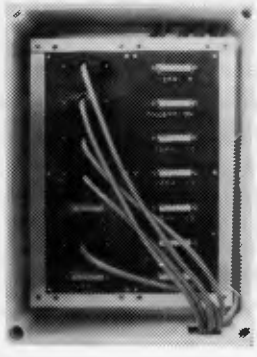

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Chequered career

Tony Harrington puts Sargon III to the test and finds that it's a good upgrade of Sargon I and II: John Nunn tries it in action.

Since designers Dan and Kathe Spracklen have already tested *Sargon IV* in competitions, you might get the impression that *Sargon III* is outmoded. Well, it certainly isn't outmoded; in fact it's the latest version that is commercially available, although its availability is somewhat limited and you may have to hunt around for a copy.

This exercise is well worth the effort, if only because the Spracklens' reputation makes any new program from them of interest. But though this latest is by no means the strongest of programs, it plays a mean — and in some cases unnerving — game.

Sargon III is disk based, running on the IBM PC and XT, and the Apple Macintosh. I tested it on an XT, which produced some weird graphic results, but it ran fine on an IBM PC.

Sargon III has all the features you expect from a screen-based chess program and also enjoys the advantage of a potentially huge user base.

As far as I know, this is the only chess program that runs on the PC. It costs $64.95.

As far as playing strength is concerned, it is some way behind the Spracklens' programs for the Fidelity range of dedicated chess computers, such as the Fidelity Elite and the Fidelity Elegance. But it is much stronger than the old *Sargon I* and *II* programs that Apple users in particular will remember.

Aside from the excellent manual, a major plus feature is that the reverse side of the disk contains 107 Great Games compiled and annotated — in the manual, at least — by US chess master Boris Baczynskyj. The point is that you can instruct the program to give you an animated move by move display of any or all of these games. Included are such historic clashes as the 1866 Anderssen-Steinitz encounter in London, and the 1974 Karpov-Korchnoi head-to-head in Moscow.

You can also build up a file of your own games against the computer, saving them to disk and calling them up whenever you want to relive past glories.

One strong point about designing a program for a proper business machine is that full use can be made of the printer facilities. *Sargon III* can be made to print out a diagram of the current board position at any point in a game (by typing Control-W) and a full list of the moves to date (Control-P).

A novelty of this program is its preference for fianchettoing its Bishops for the Modern openings. This frequently makes for a lively game, at least against human players, since the whole point of the Modern opening theory is to produce asymetrical, unbalanced positions with very sharp play.

The program uses nine of the IBM's ten function keys as 'playing level' keys, ranging from five seconds a move at level one to 'infinite' analysis on level nine.

Although there will undoubtedly be stronger chess programs for the IBM PC, this will give most average chess players a good game.

Human touch

John Nunn annotates this month's game, an encounter between an anonymous human player (White) and the *Sargon III* program (Black) operating on level 6.

1 d2-d4	**Ng8-f6**
2 c2-c4	**g7-g6**
3 Nb1-c3	**Bf8-g7**

Sargon III likes the flank development of bishops and in this game it brings both bishops into play by the same method.

4 e2-e4	**d7-d6**
5 f2-f3	**Nb8-d7**
6 Bc1-e3	**0-0**
7 h2-h4?	

A rash advance. Any textbook will tell you that the correct way to meet a flank attack is by a counter action in the centre, so Black should have played 7...e7-e5 8 d4-d5 Nf6-h5 when White would have had cause to regret such haste.

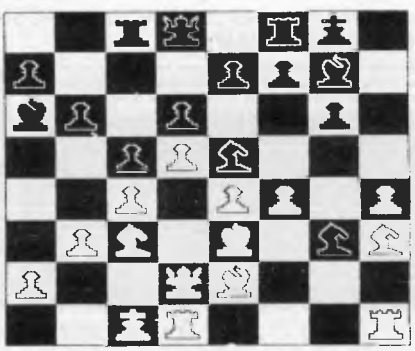
7 ...	**b7-b6?**
8 Qd1-d2	**Bc8-b7**
9 0-0-0	**c7-c5**
10 d4-d5	**Ra8-c8?**

By castling queenside White has served notice on his opponent that he intends to launch a massive kingside onslaught. Black should have reacted with equal speed, but his slow meandering development has landed him in a critical position. Here he misses his last chance for counterplay by 10...a7-a6 followed by ...b7-b5.

11 g2-g4	**h7-h5**

White threatened to augment his attack by h4-h5 followed by Be3-h6, so Black decides to halt the further advance of White's h-pawn.

12 g4xh5	**Nf6xh5**
13 Ng1-h3	**Nd7-e5**
14 Bf1-e2	**Bb7-a6**
15 b2-b3	**Nh5-g3**
16 f3-f4!	



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A 92

It's the best move of the game. By sacrificing rook for knight, White gains time and rips open the kingside files.

16	...	**Ng3xh1**
17 Rd1xh1		**Ne5-d7**
18 h4-h5		**g6xh5**
19 Nh3-g5		**Bg7xc3?**

Black was lost in any case, but exchanging off the Black king's sole defender can only hasten the end.

20 Qd2xc3	**h5-h4**
21 Rh1xh4?	

Up to here White has played well, but now he misses a number of chances to finish the game quickly. 21 Qc3-e1 Kg8-g7 22 Qe1xh4 Rf8-h8 23 Ng5-h7 would have led to a rapid mate.

21	...	**Nd7-f6**
22 e4-e5		**Nf6xd5**
23 c4xd5		**Ba6xe2**
24 e5xd6		

Again White inexplicably overlooks a simple win by 24 Qc3-c2 f7-f5 25 e5xf6 followed by a deadly queen check at g6 or h7.

24	...	**f7-f6**
25 Ng5-e6		**Qd8-e8**

This makes it easy for White but even after 25...Qd8xd6 White could win by 26 Qc3-c2.

26 Qc3-e1	**Be2-d3**
27 Rh4-g4+	**Bd3-g6**
28 d6xe7	**Rf8-f7**
29 Rg4xg6+	**Kg8-h7**
30 f4-f5	**Kh7-h8**
31 Qe1-h4+	**Rf7-h7**
32 Qh4xf6+	**Rh7-g7**
33 Qf6xg7 mate	

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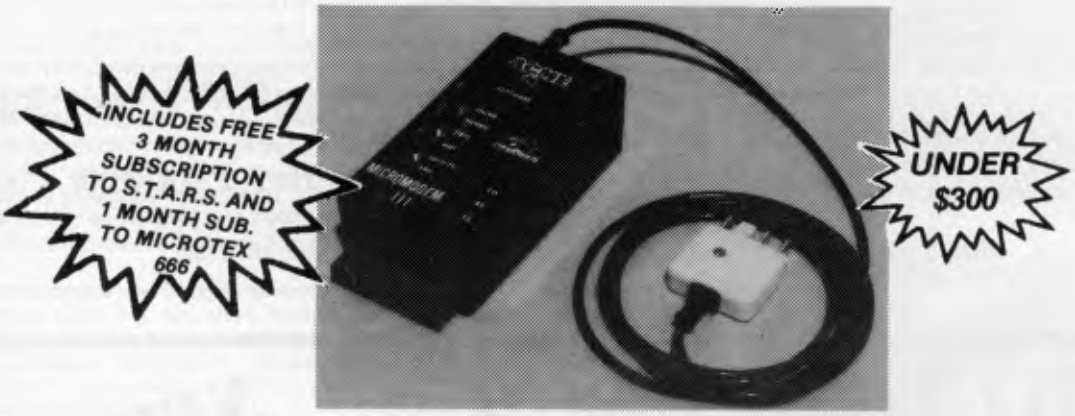

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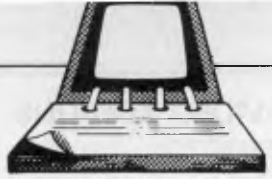

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USA	(Atlanta), Comdex/Spring Contact: Interface Group Inc, 300 First Avenue, Needham, MA 02194	May 6–9, 1985
Singapore	Asia Telecom 85 Contact: Singapore Tourist Promotion Board, 1 Alfred Street, Sydney 2000 (02) 241 3771	May 14–17,1985
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Melbourne	Videotex '85 Contact: Riddell Exhibitions, 135-141 Burnley Street, Richmond, 3121 (03) 429 6088	July 16–18, 1985
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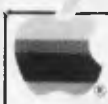

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BENCHMARKS

A list of Benchmarks used when evaluating micros is given below.
An explanation can be found in the February '84 issue.

```
100 REM Benchmark 1
110 PRINT "S"
120 FOR K=1 TO 1000
130 NEXT K
140 PRINT "E"
150 END
```

```
100 REM Benchmark 2
110 PRINT "S"
120 K=0
130 K=K+1
140 IF K<1000 THEN 130
150 PRINT "E"
160 END
```

```
100 REM Benchmark 3
110 PRINT "S"
120 K=0
130 K=K+1
140 A=K/K*K+K-K
150 IF K<1000 THEN 130
160 PRINT "E"
170 END
```

```
100 REM Benchmark 4
110 PRINT "S"
120 K=0
130 K=K+1
140 A=K/2*3+4-5
150 K<1000 THEN 130
160 PRINT "E"
170 END
```

```
100 REM Benchmark 5
110 PRINT "S"
120 K=0
130 K=K+1
140 A=K/2*3+4-5
150 GOSUB 190
160 IF K<1000 THEN 130
170 PRINT "E"
180 END
190 RETURN
```

```
100 REM Benchmark 6
110 PRINT "S"
120 K=0
130 DIM M(5)
140 K=K+1
150 A=K/2*3+4-5
160 GOSUB220
170 FORL=1 TO 5
180 NEXTL
190 IF K<1000 THEN 140
200 PRINT "E"
210 END
220 RETURN
```

```
100 REM Benchmark 7
110 PRINT "S"
120 K=0
130 DIM M(5)
140 K=K+1
150 A=K/2*3+4-5
160 GOSUB 230
170 FOR L=1 TO 5
180 M(L)=A
190 NEXTL
200 If K<1000 THEN 140
210 PRINT "E"
220 END
230 RETURN
```

```
100 REM Benchmark 8
110 PRINT "S"
120 K=0
130 K=K+1
140 A=K^2
150 B=LOG(K)
160 C=SIN(K)
170 IF K<1000 THEN 130
180 PRINT "E"
190 END
```


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Quickie

This month's quickie was submitted by Mr John Deft. Nice one John.

Three full wine glasses and three empty wine glasses stand in a row as shown below. By moving only one glass, can you arrange them so that full and empty glasses alternate.

In other words:

from this

to this

Prize Puzzle

This month's prize puzzle should not be too difficult for those of you with micros or programmable calculators, so key-in and go.

Find a 3-digit perfect square which is the average of two other 3-digit perfect squares (numbers with leading zeros are not allowed).

Answers, on postcards only, to: *APC*, Prize Puzzle, April 1985, Lazing Around, 77 Glenhuntly Road, Elwood, Victoria 3184. Entries to arrive not later than 30 April 1985.

December Prize Puzzle

The marathon event at Little Dingblat seemed to be more difficult than we had thought — only 70 entries were submitted — and several of these gave wrong solutions.

The winning entry came from J Baker of Young Town. Congratulations Mr Baker, your prize is on its way. The solution to the problem is 23 entrants in the race.

By the way, if you have any ideas for problems that can make micros whirr (or even explode) please send them in.

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CHIP CHAT

Atari acronyms: the forthcoming ST from Atari isn't named after leader Jack Tramiel's son Sam — it stands for 16-bit. The XE acronym is even more clever — X is for compatibility with the XL range and E is for 8-bit.

A great one for rubbing salt in wounds is Mr Tramiel Snr — having left Commodore last year under circumstances neither side will discuss in detail, he now intends to make Commodore-compatible peripherals. Disk drives are among his plans, although we also hear that Commodore may have some 3½in drives up its sleeve. Where Atari is getting the money to do all this is, of course, another question.

'Pick your guru carefully, like a horse': this is the advice of Mike Banahan and Andy Rutter in *Unix — the book.* They continue: 'Occasionally you may come across the Unix *expert.* Too old and weary for anything of use, these creatures are put out to grass, where they immediately elect themselves to committees and start writing books. If you have one of these, be kind to it, buy it drinks and treat it with respect. On no account ask it for advice, for its language is no longer the same as yours.' The authors themselves finished writing their book — and they are worth turning to for advice.

Trivial Fact No 437: according to a leading paper manufacturer which makes floppy disk sleeves, if you were to repeatedly remove and insert a disk from one of its sleeves a 100 times, the total build up of static charge would be less than 0.6 pico farads. You did want to know that, didn't you?

Disk in time: Tolkien addicts with access only to an IBM PC have Hobbit sustenance at hand. Disk versions of this high-selling home computer game are on their way for a range of machines, including the PC, and with extras such as enhanced graphics. At least that means when you're stuck in the Goblin's Dungeon, the surroundings should be prettier.

. . . Peter Leppik, a 15-year-old hacker who had been accused of breaking into the computer files of a Minneapolis bank, recently helped police crack the disk protection code on a sex offender's electronic diary. Peter claimed the bank break-in was 'accidental' . . . Mother Jones' Son's Software Corp has an unusual way of combating piracy. Its sales agreements state that if the buyer copies the program illegally, 'ownership of your eternal soul passes to us, and we have the right to negotiate the sale of said soul'. The agreement adds: 'Our attorneys will see to it that life on earth, as you know it, is completely ruined.' . . .

BLUDNERS

Line 2060 of the Commodore Screendump program (*APC* February 1985) is incomplete, suddenly ending mid POKE. The full line should read:

```
2060 OPEN 1,3,0,
     'SCREENDUMP':
     POKE781,D:
     POKE782,0:
     SYS65466
```


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BACK ISSUES

This Back Issues listing has been updated to include all of the available 1984 issues of APC. An order form is included at the end of the listing. Please allow up to four weeks for delivery.

Volume1 No 6, 1980
Benchtests: Commodore 8032, SuperBrain/Overview of chess machines and micro programs/Writing machine independent Basic programs/Printer review/Programs: Lunar Lander (TRS-80), PET Fighter Pilot, Apple Plotting, LPrint to Print utility (TRS-80), ZX80 Breakout, Graph (TRS-80).

Volume 2 No 3, 1981
Checkout: Sinclair ZX81/APC-80: Recovering lost programs, JUMP command (allows a GOTO "numeric expression")/Building a Bigboard/Keystroke reduction for EDTASM users/Sanders Printer reviewed/Profile of BS Microcomp/CP/M explained by Rodnay Zaks/The rapid bubble sort for the Apple/Encryption for any Microsoft Basic/An imagined 6502 "Dream Machine" specs/Vectors explained on the Challenger IP/Programs: TRS-80 flashing cursor and non-destructive backspace, Treasure Hunt (PET).

Volume 2 No 4, 1981
Benchtest: VIC•20, Tandy TRS-80 III/TRS-80 Monitor software compared/Computer Games: Backgammon on micros/Tree access routines explained/Gateways to Logic, Part 8: Peripherals/How Computers Communicate, Part 1: What is I/O?/Profile Gary Blom of the Computer Company/Part 1 of 2: Defining program specification needs/6502 Assembler in Basic/Wordpower wordprocessor program for the PET/Programs: PET Arithmetic Test, Apple Mondrian.

Volume 3 No1, 1982
Benchtest: Tandy TRS-80 Color/Checkouts: Hitachi Peach, Sharp's Microtranslator, BBC Proton/Profile of Rodnay Zaks/Sorting alphanumeric codes from disk to disk/Computer games:GO-MOKU on micros/Generating Patterns with a computer, Part 3: The parallel interface/Review of Forth Language/A neat way to describe programs quickly and logically/Speech Synthesis for the TRS-80s, System 80s, Part 1/Cassette utility for System 80 on Eprom/An easy route to shape tables for the Apple/Rubik Cube Simulation for the Apple/How to implement "Turtle" graphics on an Apple/Programs: Get Simulation (Apple), Bug Bug (TRS-80), Cryptography (Microsoft Basic).

Volume 3 No 2, 1982
Checkout: Apple III/Fitting a smooth curve to complex data plots/Speech synthesis for TRS-80s, System 80s, Part 2/"Bridge" on micros/Relocating assembly language programs/Binary sort explained/Programmable rhythm generator project for PET/Large number calculations on micros/Basic interpreters explained/Checkout: ZX81 printer/APC-80 overview and debounce routine/Storing arrays on tape/Frames of Reference, Part 1: A DP manager's guide to micros/How Computers Communicate, Part 4: The IEEE interface/Overview of micro-computer databases/Programs: TRS-80 Alien Seabattle.

Volume 3 No 3, 1982
Benchtest: Hewlett Packard HP-125/WP Benchtest: Scripsit 2.0/Checkout: Dick Smith Votrax Type 'N Talk, The Australian Beginning/Videotext overview/Frames of Reference, Part 2: Hardware and Software Suppliers/Profile: Jim Warren of the West Coast Computer Faire/How Computers Communicate Part 5: The BCD Interface/Installing hires on the TRS-80/Bridge playing program reviewed/Programs: Galacti-Cube (3D Maze in fairly "standard" Basic), PET Fantasy, ZX80 Labyrinth, PET Juggle.

Volume 3 No 4, 1982
Benchtests: Osborne 01, Micro Bee/APC-80: Command mode syntax error recovery/How Computers Communicate Part 6: The RS232 interface/80 x 24 display controller project/Preview of the Commodore 64/Atari 400 games reviewed/Profile: Adam Osborne/ANS Basic's features/Solving the hidden surface problem in 3D graphics/Frames of Reference, Part 3: Micros in mainframe company/Hewlett Packard's networking capability/Programs: TRS-80 Reaction Timing, ZX81 Graphplot, PET Cheese, Superboard Spin-Fighter, TRS-80 Extra.

Volume 3 No 5, 1982
Benchtests: Texas Instruments TI 99/4A, Xerox 820/Database Benchtest: FMS-80/TRS-80 Model I games reviewed/Frames of Reference, Part 4: Software standards/How Computers Communicate, Part 7: Interrupts in micro systems/How to use 3D graphics/Equation solving program/80 x 24 display controller project, Part 2/"Logo" Overview/Printer survey/Casio's calculator printer/Programs: TRS-80 Double Precision Maths and Trig, Apple 3D Maze,Atari Sums for Kids, Apple Air Flight.

Volume 3 No 6, 1982
Benchtests: Sinclair ZX Spectrum, Sirius I/Database Benchtest: dBase II/7th West Coast (micro-computer Faire)/Checkout: F-10 Daisywheel printer, Arfon Expandaboard/How Computers Communicate, Part 8: Direct memory access/Frames of Reference, Part 5: Buying micro hardware in a DP department/Self learning program/80 x 24 display controller project, Part 3 (end)/How to get more on Apple disks/Lisp — an artificial intelligence language/VIC-20 games reviewed/Implementing CP/M system calls from Microsoft Basic/APC Subset (first on new monthly column for assembler language routines)/Programs: TRS-80 Invader, PET Mini-animate, VIC-20 Trailblazer, ZX81 Book Index, Weebug Monitor (TRS-80), VIC-20 Large Characters.

Volume 3 No 7, 1982
Benchtests: Sharp MZ80B, Monroe OC 8820/Checkout: Sharp PC1500, The Micro-Professor/Apple II games reviewed/APC-80: Various PEEKs and POKEs explained/Reversing images on computer screens/Frames of Reference, Part 6: Putting your micro to work/How Computers Communicate, Part 9: Character codes/Educational arcade-type game/Programs: ZX81 Hypocycloids, TRS-80 Truth, PET Doc, TRS-80 Screen Dump, PET Boxes, Atari Earth.

Volume 3, No 9, 1982
Benchtest: ICL Personal Computer/Checkout: E40(CP/M data compression utility) Daisywriter printer, HP 11C & 120 calculators/BBC micro graphics capability/Best of APC's cartoons/How to use Benchmarks/Logo Program (Microsoft Basic) Computer generated textures/RS232 overview, Part 2/Memory-saving utility for Apple/How Computers Communicate, Part 11: Interrupts and buffers/Programs: Sytem 80 Extended Basic, Apple Trees, ZX81 Alphabetising, PET File Companion, PET German Game.

Volume 3 No 10, 1982
Benchtests: Hewlett Packard HP-86, National Panasonic JB3000/Checkout: Sharp PC-1211/UCSD p-System overview, Part 3 (end)/How to implement 3D graphics on a micro/CP/M-86 vs MS-DOS: Relative merits of these 16-bit operating systems discussed/Designing your own database/Monitor for TRS-80/System 80/File searching method/"Laws of Form" — a novel form of logic/How Computers Communicate, Part 12 (end)/Benchmarking high level languages/Programs: TRS-80 Cardshuffler, PET Knockout, PET Trains

Volume 3 No 11, 1982
Benchtests: Hewlett Packard HP75C, Kaypro II, DEC Rainbow/Programs for the HP41C and Casio fx702p/Algebra checking program/More on MS-DOS vs CP/M-86/Predictions in the micro industry/Clock/calendar card for the Apple II, Part 1/Benchmarks summary/Programs: Apple II Piano Computer, Moon Module (Apple II, correction in Vol 4 No 1), Walls (Atari, correction in Vol 3 No 12).

Volume 4 No 2, 1983
Benchtests: Sharp PC1251/Database Benchtest: Hi Data/Micros as best friends/A major boost to the standards of 'user friendliness'/Computing can be a health hazard/'Expert Systems' — part two: appraisal of 'intelligent' computers/Networks: Part 1/The Logo Turtle checked-out/Getting the most from the BBC's graphics/Are home computers just a passing fad?/The Prestige vs The human micro chess/Programs: Apple Character Plotter, System Tape Copier (TRS-80/System 80).

Volume 4 No. 6, 1983
Benchtest: Texas Instruments' Professional/Checkouts: Comx 35 home computer, NEC's Spinwriter daisywheel printer/Multi-Tool Word wordprocessor from Microsoft/Occam Occult: futuristic new language/The world of creative cross-figures/MicroBee games reviewed/Are micros a good idea?/Programs: Construction Worker (System 80 TRS-80), Chicken Little (Micro-Bee), PET Zombies, Spectrum Blaster, Commodore 64 Sprite editor.

Volume 4 No. 8, 1983
Benchtests: Apple Lisa, DOT/Checkouts: Osborne Executive, Epson FX-80 printer/Consumer Electronics Show Report/Will the Computer be the next dominant species on Earth/Milton Bradley's chess computer that moves its own pieces/Choosing suitable disks for your computer/Cryptography on a micro/Warnier Orr structured programming, Part 1/How to use the six function keys on the PC1500/Programs: ZX81 Least Squares, System 80 Loading tapes from an external cassette player, TRS-80/System 80 Adventure program, Apple II Pascal menu generation.

Volume 4 No. 9, 1983
Benchtests: Sord M5/Checkout: Tandy Model 100, Lisawrite/Screenplay: TI 99/4A games/

BACK ISSUES

Steve Wozniak returns to Apple/ Choosing a home micro/Warnier Orr programming, Part 2/Graph plotting and curve fitting on the BBC Computer/Bemoaning the mechanical teller/Programs: VIC-20 Snake line, ZX81 Surround, Apple II Screenplay, PET Histogram.

Volume 4 No. 10, 1983
Benchtests: Archives PC/Home Computer Survey — 15 micros selling for less than $1000 checked out by Steve Withers in an exhaustive market survey/ Checkout: Simons Basic, T/Maker III — office tool for the IBM PC, Digital Research Personal Basic/Computerising Your Business — a light and practical guide/Beginners Guide to Basic Program Conversion/ Clever trick with TI Sprites/ Cocktail program/Warnier Orr programming, Part III/How portable is portable/Programs: Atari No-Trons, TRS-80/System 80 Multi-Maths, Apple Text Maker, VIC 20 Spider.

Volume 4 No. 11, 1983
Benchtest: Apricot/Checkouts: Atari 600XL, Ashton Tate's Financial Planner, Condor database, Atari Writer/Which Spreadsheet? PerfectCalc/ Profiles: Clive Sinclair, Nolan Bushnell/Set up your own computer learning centre/Basic Converter Chart/Warnier Orr Programming Part 4: Techniques (end)/Programs: PET Wave Simulation, Apple II Aplist, Microsoft Basic Calendars, TI99/ 4A Breakout, Commodore Testing Your Fingers, Apple Dotter Puzzle, VIC-20 Starship, Commodore Maths Test.

Volume 4 No. 12, 1983
Benchtest: TANDY MC-10/ Checkout: Executive 816, Lotus 1-2-3, VisiOn, Gemini 15X Printer/Computerising Your Business: Part 2, Setting up/Sort Trees for beginners/Printing big on an Epson printer/Bulletin boards/Programs: VIC-20 Robotank, VZ-200 Missile Command, New 'Bee Screen, MicroBee Grooble Grab, Apple French Test Card, TRS-80 Road Rally.

Volume 5 No. 1, 1984
Benchtest: NEC PC-8201A/ Checkouts: Coleco Adam, Kaypro 10, Atari Paint, Desq/ Micro music — how it's done: Part 1/"Check Digits" — methods of ensuring correct data entry/Building models using surfaces, not lines/Column sort algorithm/Graphics on Tandy's Co Co/Spectrum listing: photofit/Locking Apple Listings/ Programs: Commodore 64 Fast Sprites, IBM PC Sheepdog Trials, VIC 20 Variable List/ Spectrum Lower CLS, Commodore 64 Monitor, Oric City Defense, MicroBee Tunes.

Volume 5 No. 2, 1984
Benchtest: Workslate, Commodore 720/Checkouts: Visuall, Sord's Falc, '64 Vizawrite, Brainstorm/DIY Apple Interface/ TRS-80 Disassembler/Benchmark summary to-date/Basic Program Conversion, Part 2 (Part 1 in Vol4 No. 11)/BBC Music, Part 1/Could speech synthesisers do long term damage to the language?/Programs: TRS-80 Pascal Procedures, PET Maths Maze, BBC Logic Tree, VIC 20 Grid Bike, '64 Heli-bomber, '64 Battlestar Fighter, Apple Bridge Builder.

Volume 5 No. 3, 1984
Benchtests: IBM PC Junior, Sharp MZ-700/Checkouts: Androbot's Topo, Homeword word processor, TK!Solver, Educational Games/Basic Program Conversion, Part 3: Apple II graphics/Atari memory (for patterns of colour and sound) tester/Teach Yourself Assembler, Part 1/BBC Music, Part 2/View of the future from the author of VisiCalc/Give your program cassettes a spoken index/ Programs: Apple Stargo, PET Areas, Spectrum Jackpot, Atari Split-screen, TRS-80 Sound Synthesiser, 3D 'Bee, '64 Sprite Designer.

Volume 5 No. 4, 1984
Benchtests: Macintosh, Spectravideo/Checkouts: IBM Portable PC, Unix, Visiword Plus, Spectravideo/Teach Yourself Assembler, Part 2/Basic Program Conversion, Part 4: TRS-80 and Apple II graphics/Sharp PC1500 game scoring listing/ Interview: Bill Gates of Microsoft/Microchess: 4th World Chess Championship results/ Inside Atari's research laboratory/Programs:(Microsoft Basic) Inlay Cards, BBC Splash!, VIC 20 Invaders, Commodore 64 Reversi, VZ-200 Moon Lander, ('64) Gary the Guitar.

Volume 5 No. 5, 1984
Benchtests: Hewlett Packard 150 Touch Screen, Dick Smith Challenger, Canon X-07/ Checkouts: Revelation, Concurrent CP/M, StarBurst and StarIndex, Sendata modem, Commodore SFD 1001 disk drive, Brother EP44 personal typewriter/Basic Program Conversion, Part 5: Atari/ Compaction techniques, examples in Commodore Basic/ Teach Yourself Assembler, Part 3/Text vs Graphics adventures/ Operating Systems, Part 1/ Microchess: Superstar vs Constellation/Programs: '64 Plane Attack, Commodore Wordsquare, Atari Flash Simulator, Atari Pseudo-Dos, Sord M5 Charpatt, VIC 20 Ape King, MicroBee Hires Editor, Apple II Oisterads, 'Bee Label Printer.

Volume 5 No. 6, 1984
Benchtest: Sharp PC5000/ Checkouts: Codewriter, Microsoft Word, Dick Smith Cat, Apple ProDos, Knowledgeman, Autocad/Play Battleships on two Commodore computers/The History of the Keyboard/Teach Yourself Assembler, Part 4/ Artificial Intelligence: a report from Japan/Basic Program Conversion, Part 6: Spectrum/ Spectrum "wide screen" word processing/Software Copyright: the debate/The dangers of reviewing software/Programs: TRS-80 Compiler, TRS-80 Braille Writer, VIC 20 Deathwall, Basic-86 Marvin, PET 3D O's & X's, Five W 'Bee.

Volume 5 No. 7, 1984
Benchtest: Epson PX-8/ Checkouts: Memotech, Framework, HP Ink Jet Printer, Expert-Ease, Apple's Instant Artist/Teach Yourself Assembler, Part 5/Operating Systems, Part 2/ Designing and selling programs, Part 1/Calling routines available in CP/M/The story behind MSX/ Basic Program Conversion, Part 7: BBC/Programs: '64 Balloon, Atari Function Keys, BBC Sected, MicroBee Slalom, VZ-200 Blockout, '64 Split Screen Graphics, VIC 20 Monster Hunt.

Volume 5 No. 8, 1984
Benchtest: Sinclair QL/ Checkouts: Perfect Link, Friday!, Knowledgeman (Part 2), PlanStar, Commodore 64 Flight Simulator, Constellation, Pick/ Modem protocols: XModem/ Exploring WordStar/Input and Output on the Atari/$25,000 competition: Brun's Constant/Teach Yourself Assembler, Part 6/ Designing and selling programs, Part 2/Teach Yourself Lisp, Part 1/Detente between DP departments and standalone users — the Information Centre/ Programs: VIC Hatchery, BBC RAM Editor, VIC 20 Life Game, Commodore 64 Connect-Four (note correction to this program in Bludners Vol 5 No. 10, 1984), VZ-200 Database, TRS-80 Color Grafx Editor, Atari Basic System Reset.

Volume 5 No. 9, 1984
Benchtests: Hewlett Packard 110/ Checkouts: Framework vs Symphony, overview: Portable Computers, Jane vs Appleworks, Pick/Profile: Wayne Wilson/ Teach Yourself Lisp, Part 2/ Logic of assembly language, written in convertible Basic/ Teach Yourself Assembler, Part 7/Braindump: Defence of the Gotogoto Bird *(this is a really excellent one page article — Ed)*/ Microchess: Cray Blitz vs David Levy/Programs: '64 Defuse, BBC Mindwaves, VIC 20 Gothic and Greek, '64 Brackets (an updated version appears on page 76 of Vol 5 No. 11, 1984), Spectrum File, VIC Star Scramble (note: a correction to this program appears in the Bludners section of Vol 5 No. 10, 1984).

Volume 5 No. 10, 1984
Benchtests: Commodore Plus/4, Osborne Encore/Checkouts: Model 100 disk drive and video interface, Open Access, GSX from Digital Research, Netcomm modem/Is this education software any good: opinion/DIY robotics for the BBC/Combining video and PC output on the one screen/Sorting useful-sized files without a disk/Bubble memory: has it been worth the wait/Teach Yourself Lisp, Part 3/Pirate Bulletin Boards/DIY PC-video connection/How to write great software, Part 1/Programs: Atari Autorun, Commodore 64 Basic Assembler, Apple II Menu, BBC Equation Solver, Commodore Honeypot, Atari Snake, Spectrum Voyager, VZ-200 Mini calc Spreadsheet (improved in Bludners Vol 5 No. 12, 1984), IBM PC Microcomputer Graphics, Animated '64, Spectrum Graphics and sound.

Volume 5 No. 11, 1984
Benchtest: Apricot F1/Checkouts: Olivetti M24, Sperry PC, ITT Xtra, Commodore 16, AAP's microwave news service/The demise of the philosophy of the scholar: opinion/Artificial Intelligence: mind over matter/ DIY Micro Music Circuit (to plug into a parallel port)/ Computer Musicians/Teach Yourself Lisp, Part 4/Compilers: How they work and how to buy the best/Improving Commodore 64 programming skills/How to write great software, Part 2/ Molecular electronics/Programs: Commodore 64 Superfile, Commodore 64 Mouse Master, '64 Sprite Editor, BBC graphics compiler/interpreter, Spectrum Crib Player, VZ-200 MON-200, Duelling VICs.

Volume 5 No. 12, 1984
Benchtests: IBM PC AT, Sony's MSX machine/Checkouts: Digital Research GEM, TI Speech Command, dBase III, Sunol network/Natural language processing/An introduction to the 68000 processor/Running your own bulletin board/Teach Yourself Lisp, Part 5/DIY Speech Synthesiser/How to write great software, Part III/Upgrade VIC 20 programs to the '64/Programs: Spectravideo Spectra-draw, '64 Hi-res Plot, TRS080 Automatic Cassette Indexer, Tandy Color/ Dragon 32 Brimstone Part One, Spectrum Life, DayFinder (written in Lisp), Commodore 64 Gremlin's Garden.

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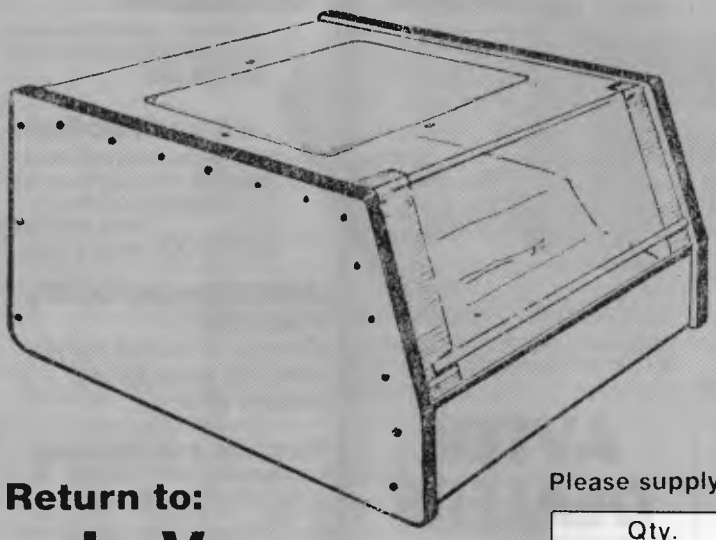

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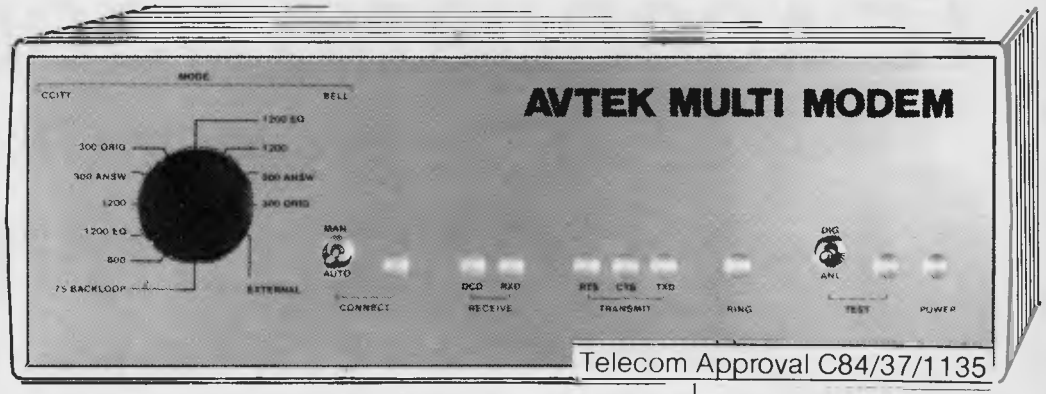

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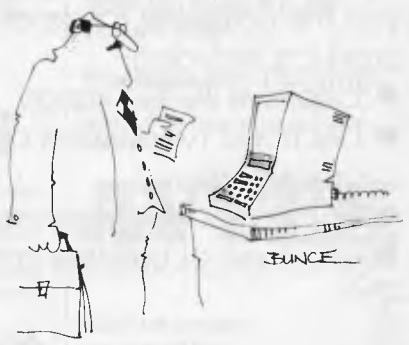

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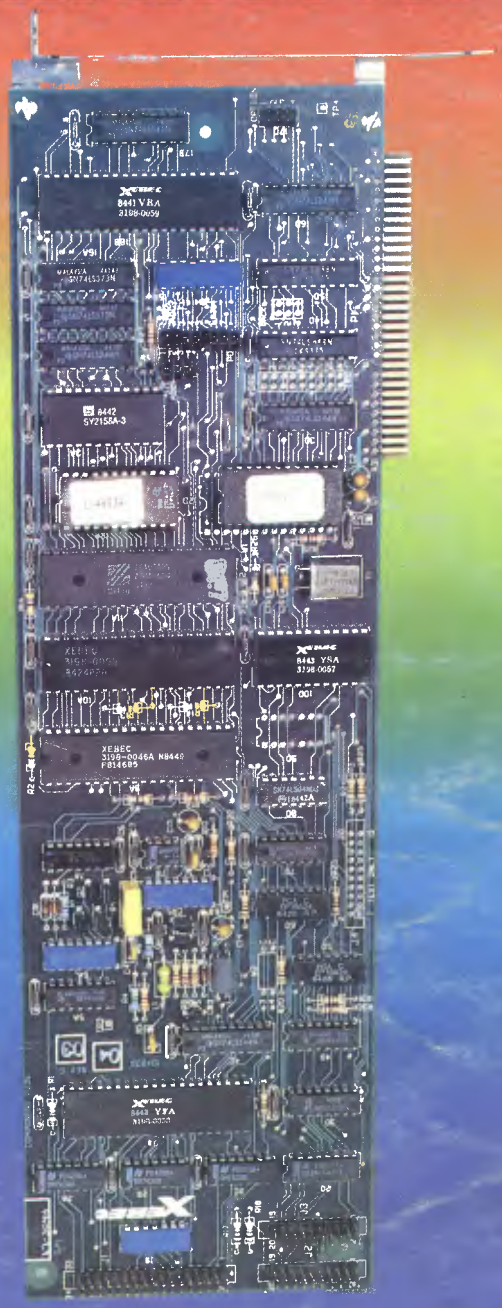

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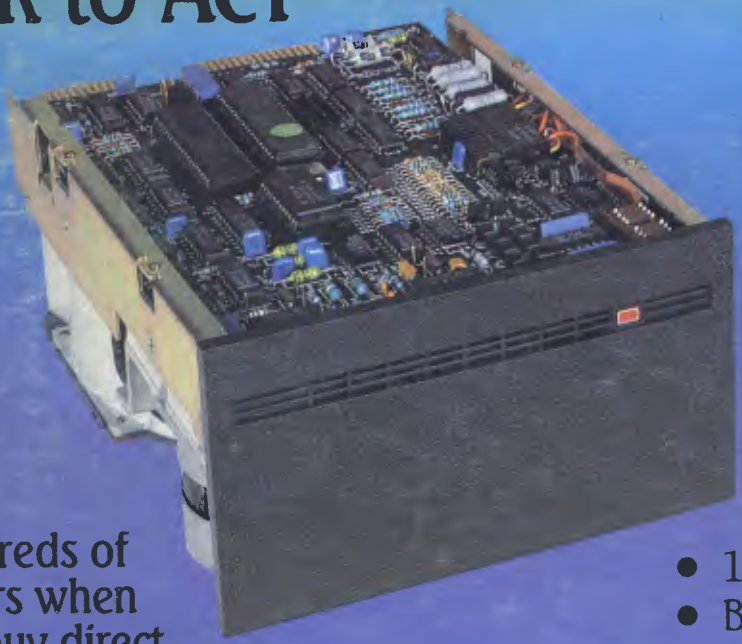

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